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ELECTRIC LOCOMOTIVE FOR MINES.

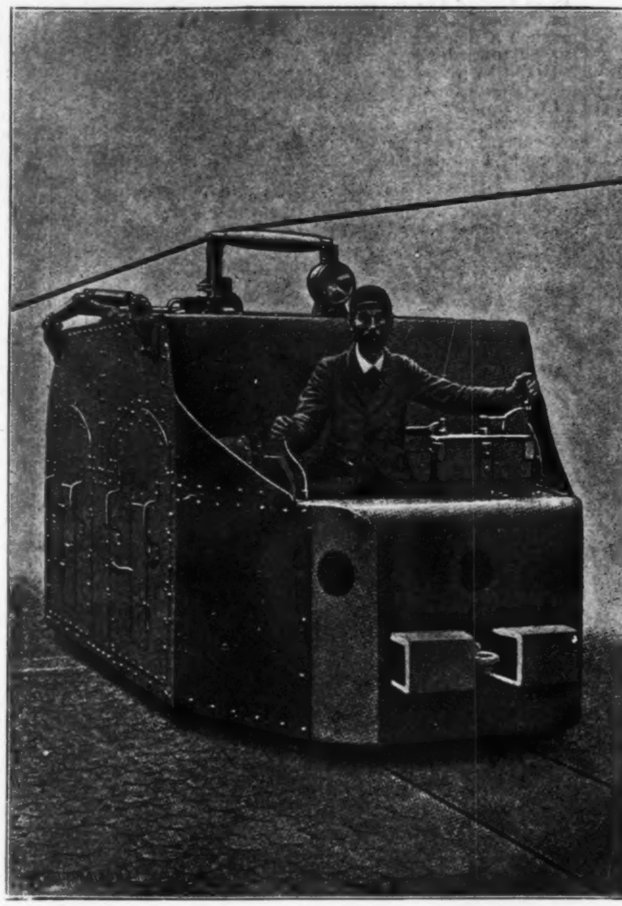
THE uses of electricity in mining are being extended continuously, and for propelling cars in mines, electric locomotives present great advantages. One of the first applications of electricity as a propelling power on a commercial scale was made in the mines of the Harz Mountains, in Germany, by the well-known firm of Siemens & Halske.

Our cuts show the electric mining locomotive constructed by the Union Elektricitäts-Gesellschaft, of Berlin, Germany. The compact arrangement of parts enables these engines to pass through narrow places, and uniformity of the exterior dimensions is preserved for engines of various powers, so that a 4 horse power engine is exactly like a 26 horse power engine in outward appearance. The outer frame is so constructed that it will receive motors of various powers, so that the design of the frame and its size are the same for all engines. The wheels can be shifted on their axles so that the engine will operate on railways of any gage from 460 millimeters (1 foot 6 inches) up to 650 millimeters (2 feet 1⅛ inches). As the gage used in mining railways varies, the adjustability of the wheels is a very useful feature.

The locomotive consists of a cast iron frame reinforced by flanges and supported on the axles by coiled springs. The motors are carefully incased, and have on their casings rearward projections forming bearings for the wheel axles. The connection between the motor shafts and the wheel axles is made by incased gearing. The switch for controlling the speed, starting the engine and reversing the motors is located at the top, near the end of the engine, so as to be readily accessible and yet occupy little room. The connecting wires are inclosed in tubes screwed upon the frame and are thus protected against injury by moisture or from other causes.

In the center of the engine is the contact arm carrying the trolley. This arm can move up and down to a considerable extent, so as to readily follow the line of the overhead conductor. When the rails can be used to form the return circuit, one trolley arm is employed; in other cases the engine is provided with two trolley arms. Sand is used to increase the adhesion of the wheels to the rails if necessary. A powerful hand brake serves to stop the engine and train.

Our third cut shows a 12 horse power engine with wheels adjustable to a minimum gage of 460 millimeters (1 foot 6 inches). The other cuts represent a 100 horse power engine developing a pull of 2,500 kilogrammes (5,700 pounds) at a speed of 2·5 to 3 meters (8 feet to 9 feet 10 inches) per second. The engine weighs 18,000 kilogrammes (40,900 pounds), and is shown as running upon a railway of 700 millimeters (2 feet 11½ inches) gage. For the engravings we are indebted to Der Stein der Weisen.



ELECTRIC LOCOMOTIVE OF 100 HORSE POWER.

ELECTRIC PUMPS FOR BOILERS.

A RECENT article in L'Electricien, says the Western Electrician, by M. P. Simon, discusses at considerable length the question of water feed for steam boilers, dividing the necessities of the case under three heads. These are:

First—The water should be both chemically and mechanically as pure as possible.

Second—It should be fed into the boiler at as high a temperature as possible, being heated by waste steam only.

Third—The feeding apparatus should be simple, economical and little liable to derangement or accident.

The third factor in the case appears to be open to more thorough discussion than the two former. In considering methods there seem to be but two which have place in the discussion—injectors and pumps.

The injector is open to serious objections. Its first cost is high; it can only be used economically with cold water; the quantity of water it is capable of handling is nearly or quite a fixed amount. If the water is heated for the injector it is expensive, because of the loss of steam used for this purpose. In addition to these objections, the injector sometimes gets out of order, and requires time (during which the boiler must be supplied by another means) to repair, as it is at best a rather delicate piece of apparatus, though not very complicated.

Pumps, on the contrary, are extremely varied, of all forms, sizes and action. They are readily changed to suit all circumstances. The rated output may be doubled or trebled with ease; they will handle hot as well as cold water without difficulty. The system is capable of the greatest flexibility with the least inconvenience.

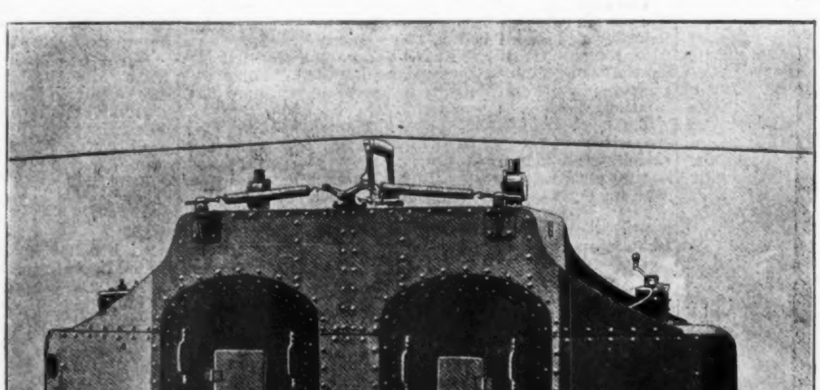
Where these are actuated directly by a pumping engine there is more work done at times than is required and the overflow runs back into the tank, making a loss of that much power. This sometimes amounts to two or three times the power utilized.

Putting these steam-driven pumps on a multiple system of boilers, where several are fed from one source, the complication of pipes, valves, etc., becomes burdensome and objectionable. When the pump is actuated by a driving belt, in case of constant demand and continuous supply, the same objections obtain. In general, an independent power supply is preferable, as indicated by the great number of donkey engines in use for such service.

But the engines consume an amount of power entirely disproportioned to the good achieved. This is not to be wondered at. As a rule, the smaller the machine, the less the efficiency. The author cites a pump which requires 400 kilogrammes of steam to produce one horse power of work.

There is an electrical method of disposing of the question. A motor, shunt wound, having a field rheostat, can be run at varying speeds and regulated with great precision by means of the adjusting coils. It will impart motion either through direct coupling or belting. One of these in service, operating a three-cylinder pump, is capable of most perfect regulation between very large limits. There are no shocks; the traction on the pulley is regular and constant. Such a pump has taken the place of a steam pump which consumed, according to circumstances, from 30 to 75 kilogrammes of steam per hour, while feeding the boiler with 600 kilogrammes of water. The horse power expense theoretically varies, then, between 130 and 340 kilogrammes of steam. Per contra, the electric motor which supplanted the engine absorbs six amperes at 110 volts, or 660 watts, which costs hardly 10 kilogrammes of steam. The economy is nearly 10 per cent. in coal consumed. Another instance is given where a similar application of electric power has effected a saving of 14 per cent. In addition to this there is a large economy in the item of oil by the electric system, which averages about 87 per cent.

A system of feeders for several boilers actuated by a single motor is suggested. A small reservoir is placed between the pump and the feedpipe running to the several boilers, each of which is fitted with a check valve and an indicator. There is no waste of steam or power, and the whole operation of water feed is made perfectly automatic and thoroughly economical. With no demand on the reservoir, the motor stops and the pump is still.



ELECTRIC LOCOMOTIVE OF 100 HORSE POWER.

ON THE CONSTITUTION OF THE ELECTRIC SPARK.*

IF a Leyden jar is discharged through metal electrodes, and the spectrum of the spark is examined, it is found that the metallic lines are not confined to the immediate neighborhood of the poles, but are seen sometimes in the center of the spark, several millimeters away from the electrodes, from which they must have been projected with considerable velocity.

It has always seemed to me to be a problem of interest to measure the velocity of projection. A knowledge of it may teach us something concerning the mechanism of electric sparks and, in addition, we may hope to obtain information on some important points in spectrum analysis, which are at present under discussion. Thus, for instance, if the speed with which a molecule is pushed forward into the center of the spark depends on molecular weight, we may separate from each other those lines of the spectrum which belong to different molecular combinations. For many years past I had made various unsuccessful attempts to deal with this problem, when I became acquainted with the elegant method used by Prof. Dixon in some of his recent experiments, in which a photograph is taken on a film fixed to the rim of a rapidly revolving wheel, of which the speed may easily be made sufficiently large to measure velocities of moving luminous particles up to 2,000 $\frac{\text{meters}}{\text{second}}$. This number might be doubled or trebled with improved appliances.

The experiments were conducted by Mr. Gustav Hemsalech, to whose care and skill their success is largely due. Without entering into a detailed description of the apparatus, it will be sufficient to say that the photographs, which I now sub-

* By Prof. Arthur Schuster, F.R.S. (Read before Section A of the British Association at the Toronto meeting.)

mit to the section, were taken on a film moving with a linear speed of about $80 \frac{\text{meters}}{\text{second}}$ in a direction at right angles to the slit of the spectroscope. The lines of the metal appear inclined instead of straight, in consequence of the finite velocity of the luminous molecules. The air lines, on the other hand, though slightly broadened, remain straight. The sparks were taken from five large Leyden jars, charged by means of a Voss machine. Each single spark produces a good spectrum, reaching approximately from $\lambda = 5{,}000$ to $\lambda = 4{,}000$.

One of the photographs, in which zinc poles were used, shows that the velocity of the molecules is gradually diminishing as they move away from the pole. Close to it the speed seems very great, the average velocity up to a distance of about one millimeter being about 2,000 meters per second. At a distance of four millimeters the speed is reduced to something like 400.

In another experiment one pole was zinc, while the other was bismuth. Some bismuth lines are found to be decidedly more curved than those of zinc, indicating a smaller velocity. But the line of bismuth, which lies at 4,560, seems almost straight.

When the poles are moistened with a solution of calcium chloride interesting results are obtained, the calcium line at 4,226 being more inclined than H and K.

The experiments were made with comparatively rough appliances, but a more perfect apparatus is in course of construction; and the author hopes to continue the research in conjunction with Mr. Hemsalech.—Nature.

SOME NOTES ON ELECTROTYPING, PLATING AND GILDING.

The following article by J. Warren is reprinted from Electricity:

Electrotyping is the art of effecting a non-adherent, metallic deposit, thick enough that the metal deposited may itself form a fresh object and be capable of a separate existence apart from the original mould, though at the same time preserving the configuration and dimensions of the latter. This art, among the earliest in which electricity plays a part, dates back some considerable time and has proved of great service in the reproduction of valuable casts, seals, medallions and other articles for various purposes.

The first step in the process is the preparation of the mould. The substance originally used for the construction of these necessary adjuncts was plaster of Paris. This substance is, however, porous and requires to be rendered impermeable. The materials most commonly used of later years are stearine, wax, marine glue, gelatine, India rubber and fusible alloys. With hollow moulds it is a good plan to arrange an internal skeleton of platinum, for ultimate connection with the anodes, in order to secure a good electrical contact with all parts of the mould. When covering several pieces at once, it is as well to connect each of them with the negative pole by an iron or lead wire of suitable dimensions.

Having prepared the moulds in the usual way—viz., by obtaining an impression in the material when soft, and allowing it to set—they should be given a metallic coating on their active surfaces of pure powdered plumbago applied with a polishing brush.

For delicate and intricate objects, that known as the wet process is most suitable. It consists in painting the object with two or more coats of nitrate of silver and ultimately reducing it by a solution of phosphorus in bisulphide of carbon.

The baths, which are the next most important item in the process, are always the same, whatever the work in hand may be, and are prepared as follows:

A certain quantity of water is put in a jar and to it is added from 8 to 10 parts in 100 of sulphuric acid, in small quantities, stirring continually in order to dissipate the heat generated by the admixture of acid and water. Sulpha'e of copper (bluestone) is then dissolved in the acidulated water at the normal temperature until it will take up no more. The solution is always used cold and must be maintained in a saturated condition by the addition of copper sulphate crystals or suitable anodes.

For use it should be poured into vessels of clay, porcelain, glass, hard brown earthenware or India rubber. For large baths wood may be used, lined on the interior with an impervious coating of acid-proof cement, India rubber, marine glue, or even varnished lead sheets.

If the solution be too weak and the current on the other hand be too strong, the resulting deposit will be of a black color. If too concentrated a solution and too weak a current be employed, a crystalline deposit is obtained. To insure a perfect result, a happy medium in all things is therefore necessary.

During the process of deposition the pieces should be moved about in the bath as much as possible in order to preserve the homogeneity of the liquid. If this be not attended to, stratification and circulation of the liquid is produced by the decomposition of the anode, and is rendered visible by the appearance of long, vertical lines on the cathode.

For amateurs and others performing small and occasional experiments, the following simple apparatus will be found very serviceable. Place the solution of sulphate of copper in an earthenware or porcelain jar, in the center of which is a porous pot containing an amalgamated zinc and a solution of sulphuric acid and water, about two or three parts in 100.

At the top of the zinc a brass rod is fixed, supporting a circle of the same metal, the diameter of which is between that of the containing vessel and the porous pot. From this metallic circle the pieces are suspended in such a manner that the parts to be covered are turned toward the porous pot. Two small horsehair bags filled with copper sulphate crystals are suspended in the solution to maintain its saturation.

I will now pass on to the process of electroplating, or the securing of thin, adhesive, metallic deposits. There are several stages to be passed through in this process, and I will take them in the order in which they come.

First, cleaning the articles to be plated. To remove grease, warm the pieces before a slow fire of charcoal or coke, or in a dull red stove. Delicate or soldered articles should be boiled in a solution of caustic potash, the latter being dissolved in ten times its weight of water.

We next pass on to the scouring process, which is effected in a scouring bath. The latter is composed of 100 parts of plain water to from 5 to 20 parts of sulphuric acid. The articles may generally be put in hot and should be left in the bath till the surface turns to an ocher red tint.

The articles, after having being cleansed of grease by the potash solution in the first place, must be washed in water and rinsed before being scoured. Copper or glass tongs must then be used for moving the articles, as they must not afterward be handled. For small pieces, suitable earthenware or porcelain strainers may be used.

The next stage is the spent nitric acid bath. This consists of nitric acid weakened by previous use. The articles are left in until the red color disappears, and so that after rinsing they show a uniform metallic tint. The rinsing should be thoroughly carried out.

The articles having been well shaken and drained, are next subjected to the strong nitric acid bath, which is made up as follows:

	Volumes.
Nitric acid of 36° Baumé	100
Chloride of sodium (common salt)	1
Calcined soot (lampblack)	1

The articles must only be immersed in this bath for a few seconds. Avoid overheating or using too cold a bath. They are next rinsed thoroughly with cold water and are again subjected to a strong nitric acid bath to give them a bright or dull appearance as required.

For articles to have, when finished, a bright appearance, plunge them for a few seconds, moving them at the same time rapidly about, in a cold bath of the following composition:

	Volumes.
Nitric acid	100
Sulphuric acid	100
Chloride of sodium	1

Again rinse thoroughly in cold water.

The corresponding bath for a dull or "mat" appearance is composed of:

	Volumes.
Nitric acid	200
Sulphuric acid	100
Sea salt	1
Sulphate of zinc	1 to 5

The duration of immersion in this bath varies from 5 to 20 minutes, according to the dullness required. Wash with plenty of water. The articles will then have a nasty appearance, which will, however, disappear on plunging them for a moment into the brightening bath and rinsing quickly.

The pieces are next treated with the nitrate of mercury bath for a few seconds:

Plain water	10 kgs.
Nitrate of mercury	10 grms.
Sulphuric acid	20 "

It is necessary to stir this bath before using it. For large articles the proportion of mercury should be greater. An article badly cleaned will come out in various shades and lacking its metallic brightness. It is better to throw a spent bath away than attempt to strengthen it.

The various pieces, after having passed through these several processes, are then ready for the plating bath.

Now for a few words on the subject of gilding. Small articles are gilded hot, large ones cold. The cold cyanide of gold and potassium bath is composed as follows:

Distilled water	10 liters.
Pure cyanide of potassium	200 grms.
Pure gold	100 "

The gold, transformed into choride, is dissolved in 2 liters of water and the cyanide in 8 liters. The two solutions are then mixed and boiled for the space of half an hour.

The anode must be entirely submerged in the bath, suspended from platinum wires and withdrawn immediately the bath is out of action.

Hot Gold Bath.—Zinc, tin, lead, antimony and the alloys of these metals are better if previously covered with copper.

The following are the formulæ for the other metals per 10 liters of distilled water:

Crystallized phosphate of soda, 600 grms.; alloys rich in copper, 500 grms. castings.

Bisulphide of soda, 100 grms.; alloys rich in copper, 125 grms.

Pure cyanide of potassium, 10 grms.; alloys rich in copper, 5 grms.

Pure gold transformed into chloride, 10 grms.; alloys rich in copper, 10 grms.

Dissolve the phosphate of soda hot in 8 liters of water, let the chloride of gold cool in 1 liter of water; mix little by little the second solution with the first; dissolve the cyanide and bisulphide in 1 liter of water and mix this last solution with the other two. The temperature of the bath may vary between 50° and 80° C.

Silvering.—For amateurs a bath of 10 grms. of silver per liter is sufficient. Dissolve 150 grms. of nitrate of silver, equivalent to 100 grms. of pure silver, in 10 liters of water and add 250 grms. of pure cyanide of potassium. Stir it up until completely dissolved, and then filter the solution. Silvering is generally effected cold, except in the case of small articles. Iron, steel, zinc, lead and tin are better if previously copper plated and then silvered hot. The cleaned articles are first treated in a nitrate of mercury bath, being kept continually in motion.

With excess of current the pieces become gray and blacken. In the cold bath anodes of platinum or silver should be employed. Old baths are in this case preferable to new. They may, if required, be artificially aged by the addition of one or two parts in 1,000 of liquid ammonia.

If the anode blackens, the bath is poor in cyanide. If it becomes white, there is too much cyanide—the deposit being too rapid, does not adhere. The deposit may be taken as normal and regular when the anode becomes gray during the passage of the current and white again when it ceases to flow.

We now pass on to the subject of nickeling. The first experiments in this industry were due to Smee, who was followed by Becquerel and afterward, in 1869, by Dr. Isaac Adams. The vat should be of glass, porcelain or earthenware, or a case lined with impermeable gum. The best nickel bath is prepared by dissolving to saturation, in hot distilled water, nickel sulphate and ammonium, free from oxides of alkalies and alkaline earthy metals. The proportion of salt to dissolve is one part by weight to ten of water. Filter after cooling and the bath is then ready for use.

When the bath is ready and the battery set up, the wires from the latter are joined by means of binding screws to two metal bars resting on the edge of the vat. The bar joined to the positive pole of the battery supports, through the intervention of a nickel plated copper hook, a plate of nickel, constituting the soluble anode, which restores to the bath the metal deposited on the cathode by the electrolytic action. From the other bar are suspended the articles to be plated. These latter should be well polished before being put into the bath. To remove all grease from them, scrub them with brushes soaked in a hot solution of whiting, boiled in water and carbonate of soda.

Copper and its alloys are cleaned well in a few seconds by immersion in a bath composed of ten parts by weight of water and one of nitric acid. For rough articles, two parts of water, one of nitric acid and one of sulphuric acid. For steel and polished castings, 100 parts of water to one of sulphuric acid. The articles should remain in the bath until the whole surface is of a uniform gray tint. They are then rubbed with powdered pumice stone till the solid metal appears. Iron and steel castings are left in the bath for three or four hours and then scrubbed with well sifted sand.

If the current be too strong, the nickel is deposited gray or even black. An hour or so is time enough to render the coat sufficiently thick and in a condition to stand polishing. When the articles are removed from the bath they are washed in plain water and dried in hot sawdust.

To polish the articles they should be taken in the right hand and rubbed rapidly backward and forward

ELECTRIC LOCOMOTIVE OF 12 HORSE POWER.

on a strip of cloth soaked in polishing powder boiled in water, the cloth being firmly fixed at one end and held at the other in the left hand. The hollow parts are polished by means of cloth pads of various sizes fixed on sticks. These pads must be dipped in the polishing paste when using them. The articles, when well brightened, are washed in water to get rid of the paste and the wool threads, and finally dried in sawdust.

THE GLASGOW CABLE RAILWAY.

AT the beginning of the present year the walls of Glasgow were covered with immense illustrated posters announcing the setting in operation of a district subway of an underground railway, "the only subterranean cable railway in the world, without steam or smoke, having a perfect system of ventilation, permitting of making the circuit of the city in half an hour, and carrying passengers from one station to another in two and a half minutes."

FIG. 1.—INTERIOR VIEW OF ONE OF THE TUNNELS OF THE GLASGOW RAILWAY.

The fact is that Glasgow, like Budapest, imitating cities of larger size, is giving Paris a good example to follow in the possession of a railway that is at present rendering the greatest service to city travel.

A mere glance at a plan of Glasgow will show that the city, inclusive of its outlying wards, is divided in two by a river, the Clyde, which is much deeper than the Seine, and the bed of which is formed principally of sand and gravel. Finally, let us add that, in addition to the difficulties resulting from the watersoaked nature of the ground, there were found pockets of water in old quarries, and it became necessary also to construct retaining work in some abandoned mines that had to be traversed.

The line under consideration is circular, but is not located at the periphery of the city, as such a position would render it perfectly useless. It was desired principally to connect the western quarters, Millhead and Partick, and especially those which, like Govan, are so much the more isolated in that they are on the other side of the port, with the heart of the city and the central station of the railways. The service had to be as frequent as that of tramways, and afford a speed of from 11 to 12 miles an hour, inclusive of stoppages.

The extent of the circle which is thus described is about six miles, which is considerable in view of the fact that the establishment of this line was not decided upon until 1890 and that it has been in full operation since the beginning of 1897.

The road is provided with two tracks, each in a separate tunnel, so as to diminish the cubage of the excavation and to facilitate the ventilation by the passage of trains always in the same direction.

These tunnels are cylindrical tubes of brick and concrete or of metal, of 11 ft. internal diameter, separated by a space varying from 30 in. to 6 ft. in width. The metallic rings are made of segments of cast iron provided at the circumference with flanges that permitted of assemblage by bolts, the joints being rendered tight through the interposition of oak. A system of drainage is provided all along the two tunnels in order to carry off the water, which at certain points is raised by pumps. The stations, which are fifteen in number, are sufficient for a length of 6 miles, since this supposes them to be very near each other on an average. Several get their light from the exterior, through glass overhead. Certain of them, in fact, are at such a depth only that the rail is at a level of 13 ft. from the surface of the street. With others, the corresponding distance reaches, as at Buchanan Street, 39 ft. or over. As a general thing, the passengers who descend from the street to the platform by special stairways have to travel a vertical distance of about 19 ft. Electric elevators, however, are in course of construction at Buchanan Street and Saint George's Cross, the two deepest stations. For each station there is a single platform, which is situated between the two tracks and rises to the level of the floor of the cars, according to the excellent English method. It is to be remarked that upon this line, in which gradients have been almost completely avoided, save at the double passage of the Clyde, each track presents an incline of $\frac{1}{50}$ at the entrance to the stations and a like one at the exit therefrom.

This is, on the one hand, for facilitating the stoppage of the trains and seconding the action of the brakes, and, on the other, for rendering the starting easier and suppressing an abnormal strain upon the cable.

Before speaking of the latter, of the exploitation and of the rolling stock, let us say a word as to the excavation of the double tunnel. This was established in part only by means of a shield, say for about a third of its length, and where it is now formed of iron segments; but in the sections where it could be made of brick and concrete, the contractors, Messrs. Simpson & Wilson, had to use a great deal of ingenuity in order to contend against moving earth and the influx of water and to protect the buildings and even the railways under which the work had to pass. Sometimes, as with the ground in the vicinity of the Clyde, it was possible to proceed according to the system called "cut and cover," that is to say, to establish a cutting in which were constructed in the open air the invert, the lateral walls and the vault. At least 140 running feet were constructed per month. At the Cowcaddens station the method employed was one that was devised long ago at Glasgow for other work and imitated at Paris for the Sceaux Railway.

This consisted in making an excavation sufficient for constructing the vaults upon a mass of earth performing the role of centerings, and then finishing the work subterraneously. The work was complicated in that the running of the surface tramway cars could be interrupted for only a short space of time and at night, and that it was necessary to support a huge water main above the cutting. At certain points the vaults could be constructed in the same way, but the work had to be completed with compressed air and air locks, in effecting a great saving over iron tubing, although the compressed air escaped in large quantities through the earth. Sometimes recourse was had to the iron tunnel, but without compressed air, when impermeable strata were traversed and it was desired to avoid any ramming at the surface. Shields were also employed, and these had the advantage of sustaining the mass of earth during the excavation and the putting in place of the iron segments. Naturally, also, the shield and compressed air were used simultaneously at the different points where the ground was watersoaked—in the crossing of the Clyde, for example. Here, since the depth under the river bed was slight, the compressed air often forced its way through the bed and made a hole therein which it was very difficult to fill up. It became necessary to set up framework in front of the shield, and to regulate the pressure of the air according to the height of the water in the river, etc. Upon the whole, all the difficulties were surmounted with a skill that does honor to the engineers and contractors who brought the work to a successful finish.

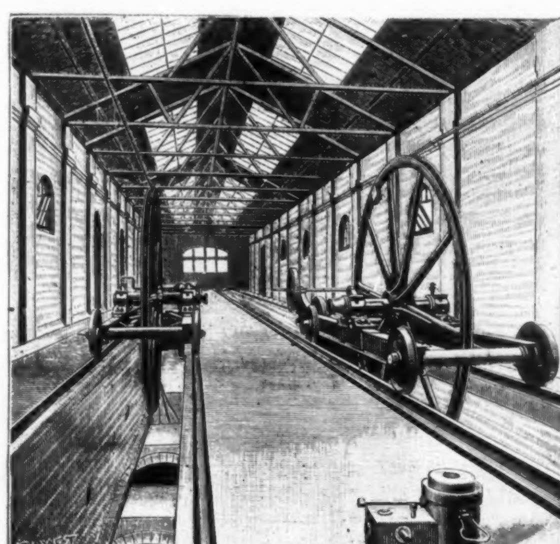


FIG. 2.—MACHINERY FOR TAUTENING THE CABLES.

We have said that the propulsion is by cable. It is assured by two central 1,500 horse power engines, of which only one is operating. At present, since the traffic is as yet small, only 400 horse power is used. The cables, which run all along the track over vertical sheaves, and are tautened at the extremities by a special apparatus, are 1·3 in. in diameter. Each of them weighs 58 tons. The cars are attached thereto by a grip that can be opened instantaneously. These cars are very long and are mounted upon trucks. They run upon a track of 4 ft. gage. The interior is plain, but sufficiently comfortable. They are lighted by means of electric lamps that take a current from a conductor fixed to the wall of the tunnel. They have a platform at each extremity, with two entrances only, these being sufficient for a population which is capable of "making haste slowly." They have sufficient capacity to seat 42 persons and allow standing room for as many more.

In conclusion we may say that at present there are but eight cars running simultaneously upon each circular track. This, however, gives one train every five minutes. At first, the cars were run from eight o'clock in the morning until eight at night, but the success of the line quickly forced the management to run them from a quarter past seven till a quarter past eleven. It has been recently stated that trains of two cars are soon to be put in service.

The cost of the railway was not so very high, since the total expense of establishment, inclusive of the rolling stock and central power house, was but £1,100,000. —La Nature.

A TUBE TUNNEL UNDER THE SPREE.

A TUNNEL possessed of some interest from a technical point of view—more, perhaps, in connection with the condition of the soil (sand) through which it is being carried than as regards its actual construction—is at present being built under the River Spree, between Stralau and the Treptow Park, where the exhibition was held, and for which purpose it was originally intended. The tube tunnel has a length of about 1,510 feet, the breadth of the river being about 670 feet, the depth on that spot 11 feet, and the bottom of the tunnel some 25 feet lower than the bottom of the river. The inside diameter of the tube is 13 feet, and the tube itself is circular. The tube consists of rings of about 2 feet breadth, made up of nine pieces; these are of pressed steel, and connected by means of bolts. The tunnel tube is surrounded by a layer of cement, the thickness of the steel plate and the protecting cement layer being respectively 10 and 80 millimeters. The permanent road inside the tunnel is also made of concrete. The shield, in which the workmen are, is a tube of somewhat larger dimensions than the tunnel itself; and it is pressed forward by hydraulic pressure, its front end being beveled so as to be better able to cut its way through the soil. The front of the chamber, in which the men work in compressed air, has apertures, which can be closed airtight, through which the soil can be worked and loosened. The working chamber is divided into two compartments; the men in the outer are employed in removing the soil, while the cementing is done in the second. The average progress is some 2 feet to 3 feet per day, although about twice the distance has been compassed when special pressure has been put on. So far everything in connection with the undertaking has worked satisfactorily.—Engineering.

The experiment of double rudders on warships has produced such altogether unsatisfactory results that those now in use will be taken off at once, and no more will be tried. Two rudders, one forward of the other, were put on the gunboats Helena and Wilmington, the remarkably light draught of those vessels giving little room for attaching one good sized rudder, and as these vessels were also designed for maneuvering in narrow river channels, the twin steering expedient was adopted to increase their obedience to the helm. On their sea trials these vessels were found to steer admirably at full speed, but when they dropped to four or five knots, which is deemed a good river rate, the men at the wheel lost all control of them, and they could not be made to respond to the helm. In subsequent trials the forward rudder was fastened straight astern, and immediately it was found that the ship behaved admirably. Orders have therefore gone to New York, where the Helena is in dock, to take off the forward rudder and fill in the hole it occupied, and the Wilmington, which was on the point of sailing for Montevideo, will be sent to the Norfolk yard in a day or two for the same alterations, which will delay her at least twelve days.

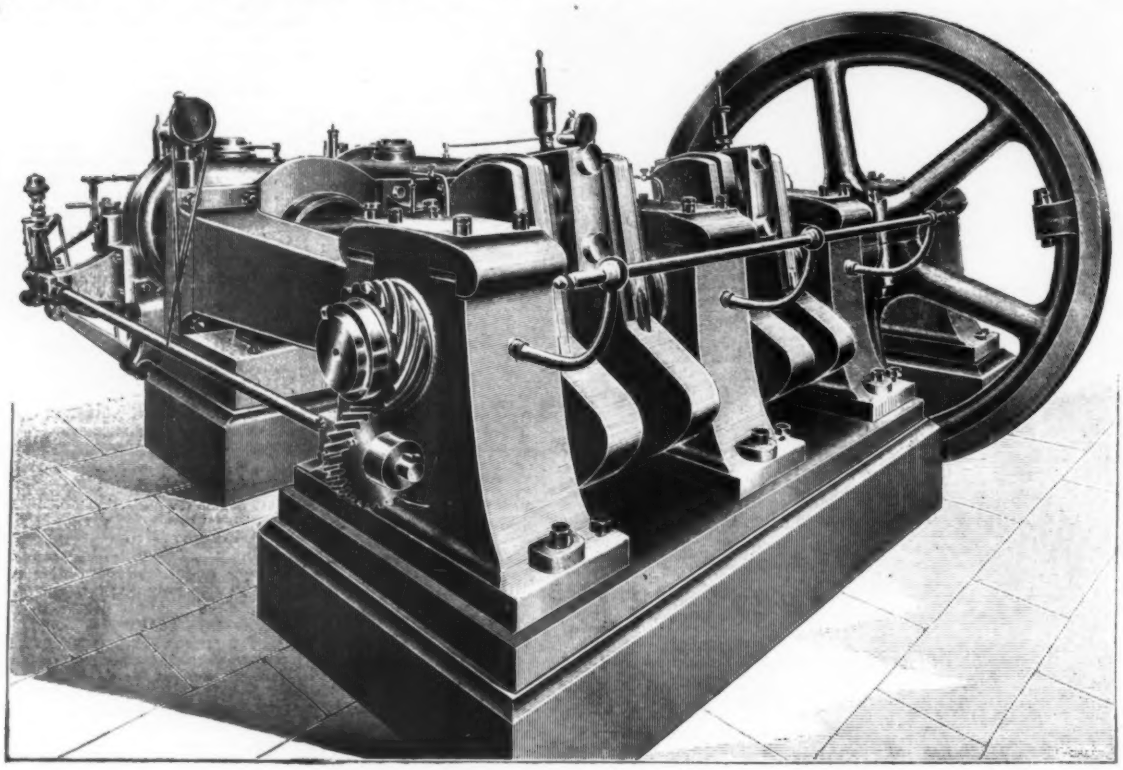
A MODERN GAS POWER PLANT.

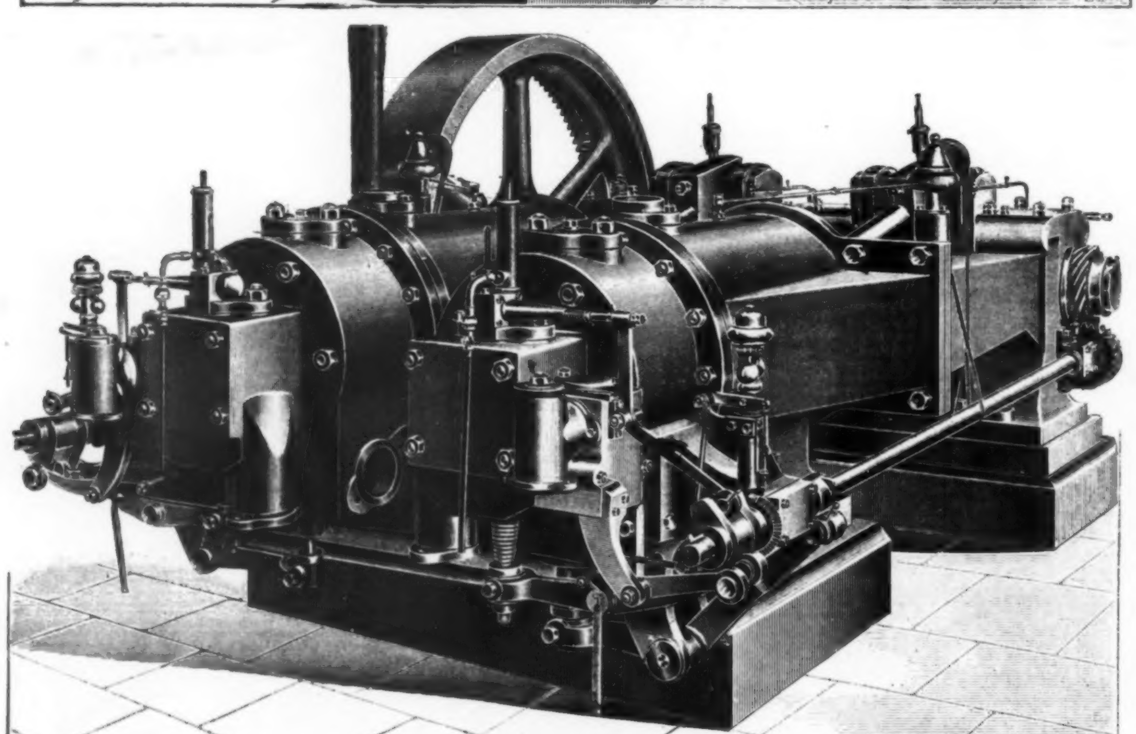
By Horace Allen, C.E.

The gas generator plant reported on below is of 300 horse power capacity, and works on the Thwaite patent continuous cycle. The apparatus consists of two cylindrical vessels side by side. The fuel is fed into the hopper at the top, and air is supplied by a fan driven from the main engine. The gas, as it leaves the bottom of the second generator, has a high temperature, and is made to heat the incoming air by means of a recuperator apparatus, thus restoring a considerable amount of heat to the generators. From the recuperators the gas passes through a physical purifier to the pressure governor holder, which automatically governs the supply of gas to balance the demand, and from which the gas engine receives its supply. The analyses of the gas, and its thermal value, prove the excellence of the system.

The gas engine, made by Messrs. Hartley & Petyt, is of the duplex type, having two cylinders 16 in. diameter, side by side, the length of the stroke being 2 ft.; and as they are arranged for the Otto cycle, there is one firing stroke every revolution when fully loaded. The speed is 140 revolutions per minute. The charge of gas and air is compressed to about 90 lb. per square inch above the atmosphere, and the pressure of the explosion is about 300 lb. per square inch above the atmosphere. To facilitate the starting of the engine it is necessary to reduce the pressure due to compression; for this purpose a cam is provided which allows a portion of the charge to escape into the exhaust. The design is thoroughly mechanical, and the physical proportions of the machine are adequate for their purpose. There is so little vibration that a penny stood on edge on the cylinder, either lengthwise with the engine or crosswise, was not shaken down. The photograph shows the teeth on the fly wheel into which the pinion of the small starting engine gears; this engine is of the vertical type, having a cylinder 6 in. diameter.

The balancing of the crank has produced very steady turning, the timing valve is simplicity itself, and the best point of firing can be instantly ascertained. The lubrication is on the circulating principle, a small pump effecting this. Both tube and electric ignition gear are applied to the engine. The engine house is covered with a water tank, which feeds the circulating mains of the engine. The hot water is used in the dye vats, so that there is no loss of heat from this source. Another heat loss of ordinary plants is that of the sensible heat of the gases evolved from the gas generators. In the plant under consideration this heat, representing 20 per cent. of the total heat of the fuel, is restored for two purposes, one of which is the drying of the textile materials—an important industrial function—and the other is the restoration of the heat to warm the air used in the gasification process, and for the purpose of increasing its moisture absorbing characteristics; this last development is covered by one of the Thwaite patents.—The Engineer.





ONE HUNDRED AND FORTY HORSE POWER DUPLEX GAS ENGINE.

WORKING AND HARDENING STEEL.

"Nearly all persons, in writing on the proper method of working steel, lay too much stress on overheating, or what they term 'burning steel.' During my experience, I have found that there are more steel tools destroyed by working too cold, or improperly manipulating on the anvil, than from any other cause. The uninitiated have heard so much about burning steel that they are really afraid to bring a piece of steel to the proper heat for forging purposes. I have often seen the novice working steel down to a black heat under the steam hammer, not only destroying the structure of the steel, but the hammer dies also.

"A man working at the fire next to mine continually had complaints coming to him about his tools being burnt; in fact, his tools would come back broken off about one-half inch from the point, showing a coarse, black structure, similar to a piece of overheated or disintegrated steel. The poor fellow was hammering away on cold steel all day long. Finally he said to me, 'Why is it that they all tell me that my tools are all burnt, when I work them at a much lower heat than you do; yours do not break short, mine do.' I told him that his tools were not burnt, but improperly manipulated on the anvil, i. e., worked too cold, and not properly hardened after being brought to the proper shape. He replied: 'If I were to bring steel to the heat you do, they would all break off about three-fourths inch from the point.' He then showed me many of his tools broken off as described. I examined the tools which were not broken, and which had given good service after the last dressing, and found that nearly all of them had been reinforced about three-fourths inch back from the point; this compression is almost imperceptible to the naked eye, but can easily be felt by passing this part of the tool between the thumb and finger. I informed him that the next time he dressed these tools they would break at the point mentioned as soon as put in service, and show a dark, coarse structure, similar to overheated steel; the men using the tools would upbraid him for burning the tools.

"The cause of so many tools breaking at this point is improper hardening, or rather, the hardening and tempering are done too quickly, leaving a hard and soft section in conjunction with each other; consequently, the hard section is driven into the soft, displacing the

original structure at this point and making it unfit for any purpose; unless the piece is cut off at this point when dressed, it is liable to break off by dropping on the floor. To avoid this, heat your steel sufficiently to harden the whole length of the taper point, and retain heat enough in the body of the tool to draw the temper slowly; if the tempering is done too rapidly, or the blue color allowed to run too fast, then submerge in water to stop its further progress. At the junction of the bright and blue color the hard and soft section is formed with the above results. The color should run very slowly, so as not to produce any sudden change in the structure of the steel when tempering. The above articles refer to tools that are subject to impact force or heavy blows, such as stone cutter's tools, chipping chisels, etc.

"Improper manipulation in forging causes many imperfections in steel tools. When the piece to be forged is of uneven shape, the force of the blow from the hammer must be governed by the section of the piece it is shaping. In nine cases out of ten, where chisels are found cracked on the corner, it is caused by striking the edge of the chisel when too cold, causing compression to take place a little below the surface that received the blow. Some persons claim that these cracks are caused by uneven heating before hardening; others call them 'fire cracks.' Admitting the fact that uneven heating will produce similar flaws to those referred to, my experience has taught me that they are mostly caused by improper hammering on the anvil.

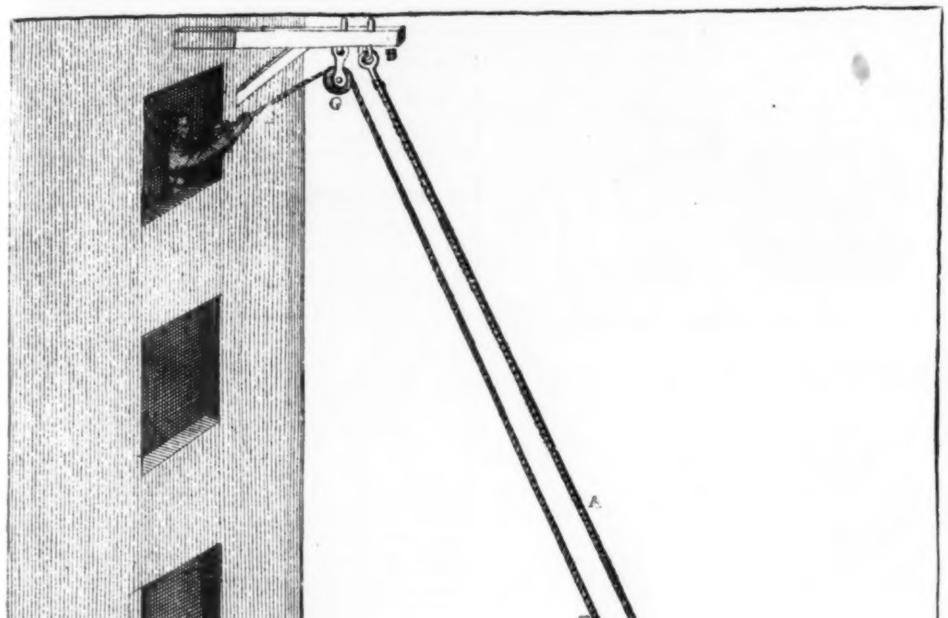
"Steel tools that have to be finished in the lathe or planer, such as taps, dies, milling tools, etc., great care should be taken in forging. If the steel has to be reduced from a large to a small section, bring the steel to a bright red heat for the purpose. Every blow struck should affect the piece from surface to center; if the piece is worked too cold, the blows affect the piece only partially through its section, causing two structures in the same piece; consequently, the uneven structure will maintain itself through all the operations in finishing the tool, and when completed it will not give satisfaction. This class of tools, after being finished, will come back to the smith to be hardened.

"The conditions in heating steel for forging purposes and heating finished tools for hardening are vastly different; in the latter case great care must be taken in heating; the whole piece to be hardened should be heated slowly and uniformly over the whole piece, as some steel will harden at a lower heat than others. The smith should know, before heating a costly tool, the necessary heat, when plunged into water, to produce the hardness required; overheating in this case means destruction to a costly tool. If it is a complicated tool, having delicate projections, baths should be prepared, which are not as good conductors of heat as the bath for ordinary purposes, as the slender projections will cool much more rapidly than the body of the piece. Oil is often used for this purpose, but any liquid will answer that will give the thin projections sufficient time to cool, at the same time producing the hardness required. We should always bear in mind that it is the time it takes a piece of steel to cool that determines its hardness, other conditions being equal."—President Wren, at Convention of National Railroad Master Blacksmiths' Association.

VERY CONVENIENT MACHINE FOR DRAWING WATER FROM A WELL REMOTE FROM THE HOUSE THROUGH A FIRST OR SECOND STORY WINDOW.

AFTER stretching the rope, A, as tightly as possible from the point, A, beneath the window, to the point, C, near the well, and after passing the rope over the pulley, D, so that the latter can roll freely up and down, the rope, F, that carries the bucket is passed over the pulley, E, and then over the pulley, G.

In this way, in measure as one slackens the rope, F, the bucket, through the pulleys, D and E, that follow it, will descend diagonally from the window to a point above the well, where the pulley, D, will meet with a knot, A, in the rope, and will stop there along with the pulley, E. Then, in continuing to slacken the rope, F, the bucket will be made to enter the well, into which it will descend perpendicularly in order to draw up water therefrom. Upon the rope, F, being pulled after the bucket has been filled, the latter will ascend perpendicularly from the bottom of the well to the knot, A, and then diagonally, along with the pulleys, D and E, from the knot up to the window.—From Recueil d'Ouvrages Curieux de Mathematique et de Mécanique, 1733.



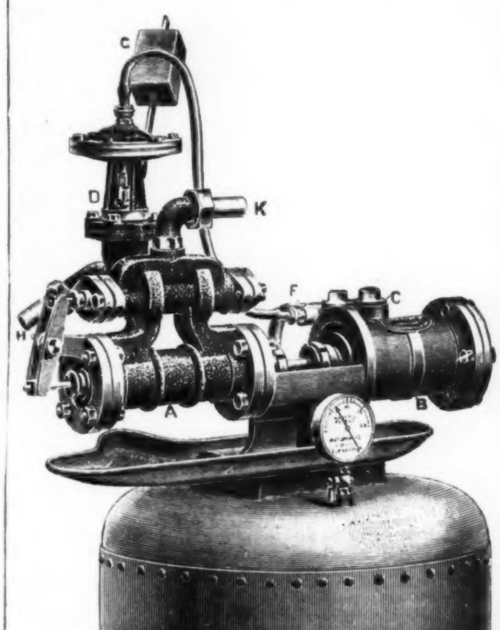
VERY CONVENIENT MACHINE FOR DRAWING WATER FROM A WELL REMOTE FROM THE HOUSE THROUGH THE WINDOW OF THE FIRST OR SECOND STORY.

IN tearing up a siding on the Straitsville Division of the Baltimore and Ohio Railroad, the other day, the section men discovered that several of the rails had been made in 1863. Subsequent investigation revealed the fact that these rails were part of a lot that were bought in England during the war, at a cost of $125 per ton in gold. The rails were still in very fair condition, and for light motive power might last ten years longer.

KEITH'S AUTOMATIC LIQUID ELEVATOR.

AT the recent Brewers' Exhibition, in London, a new device for forcing beer to the delivery faucet was shown. This device is Keith's automatic liquid elevator, which has been successfully applied to the raising of beer under pressure, as opposed to pumping by the so-called "beer engines." It is stated that the old-fashioned method of drawing beer has one great disadvantage—the abstraction of the natural carbonic acid gas. In Keith's apparatus the beer is forced out of the barrels by compressed air supplied by a pump actuated by water pressure derived from the ordinary mains. By this means it is claimed the air simply acts as a weight, and is prevented from coming into direct contact with the beer by the layer of carbonic acid gas on the surface, CO_2 having a greater specific gravity than air.

The apparatus illustrated herewith is placed in a cellar or basement and connected to the ordinary service water pipe on the one hand and to the top of beer or other casks or closed vessels on the other hand. This compact little engine consists of three main parts, viz.: (1) The water cylinder, A; (2) the air pump, B; (3) the automatic governing valve, D. The water cylinder has a positive valve motion, is connected to the water main at H, and exhausts at K, the governing valve, D, being connected to the water pressure inlet. The air pump, B, is double acting and connected direct to the water cylinder, A, but owing to the open air space between



KEITH'S AUTOMATIC LIQUID ELEVATOR.

them, it is impossible for any water to get into or near the air pump. The air pump valve box, C, is separate and can be detached by merely unscrewing one nut, each valve being accessible in a moment. The air delivery pipe, F, is preferably connected to the air receiver, which again supplies the air pipes leading into the top of the barrels or other closed vessels, or these can be directly supplied from the air pump, B, and the air receiver can be dispensed with. The governing valve, D, is operated by the air pressure and is exceedingly sensitive; when the pressure reaches the required point, it automatically shuts off the water from the cylinder, and so stops the motor. When the air pressure falls, however slightly, owing to liquid being drawn, the valve, D, instantly opens and the engine starts working until the pressure again reaches the normal. This controlling valve, D, is entirely new in principle and works most efficiently, and in quite a different manner from some forms of regulating valves, which generally require from one pound to three pounds variation of air pressure to move them. The working air pressure can be readily adjusted to suit circumstances by moving the sliding weight, G. The makers of this apparatus are the Water Motor and Automatic Liquid Elevator Company, Limited, Farringdon Street, London.—Engineer.

THE EARLY HISTORY OF CAST IRON PIPE.

AT one of the meetings of the New England Water Works Association, Mr. Jesse Garrett, of Philadelphia, dealt with the history of the manufacture of cast iron pipe, from which the Bulletin has culled the following:

Cast iron was known to Holland in the thirteenth century, and stoves were cast at Elass in 1400. But tradition has it, which an ancient Roman writer records, that the temple of the "Great Mother," at Sparta, is said to have been built by Theodorus, who first discovered the art of casting and making statues in iron. All this is necessarily vague, a condition which suggests a quotation from Dr. Greene, of the Boston Historical Society, in reference to the present disturbance of King's Chapel burying ground for the subway human conduit. "It is so full of bones and remains that I do not believe you could dig down to the depth of much more than an inch without turning up the dust of ancient worthies." The application is this, that in the dust of these "ancient worthies" it is impossible to verify the individual instance. As with the metal itself, so its discovery in the form of cast iron was an accident which occurred at one of the early iron works in the Rhine provinces, where a part of the "running" one day was found to be of different texture, and it was a problem for some time what to do with the strange stuff.

The first blast furnaces appeared in the Thuringian Mountains, which were almost identical in principle with the present furnaces, with the exception that hand or treadmill bellows were used for the blast, from which the present mechanical blowers are an evolution. In 1377 the first cast iron gun was cast in Erfurt, and the famous Krupp was casting guns in 1818, so that it appears iron was mostly used for destructive and not Samaritan purposes through many centuries of its history. In 1685 the first cast iron pipes were used for the water service of Versailles, followed by screwed and flanged pipes. In 1708 the Quaker, Darby, patented the system of box casting, and in the following year started the famous Coalbrookdale foundry, which, in 1780, turned out the first cast iron bridge. The first casting in the United States is said to have been made at Lynn, Mass., a cast iron pot, which was exhibited at the World's Fair at Chicago.

In the region of Alba Longa, buried by the volcanic eruption which drove the Albans to the present site of Rome, no trace of iron is found, and its absence is still notable in the archaic tombs of Rome. The metal for their implements, of whatever kind, was of bronze, and the early Roman religious sentiment shows such an abhorrence of iron as to make it a profane innovation to use it in almost any form, especially in and around their sacred temples. This superstition continued after the Christian era, even down to the fall of the empire. In their religious rites, if iron had in any way approached a temple or shrine, sacrifices were instituted to expatiate the profanation, so that we can hardly wonder that their attention was not turned to it as a substitute for lead pipe. When iron tools came to be used for engraving, and were so employed on certain altar inscriptions, penitential sacrifices were afterward offered by slaying a cow or a sheep on the altar. Bronze plows were used long after the introduction of iron plows. The high priests of Rome would not shave or have the hair cut with iron instruments.

The first mention of iron pipes I find was in an elaborate system built at Marli, near Paris, and set to work in 1682, costing $1,500,000. The account says: "They drew the water by short suction pipes from the River Seine, and forced it through iron pipes up the hill. They climbed to a height of 533 feet by a series of reservoirs and pumps, but this system came to be known as a 'monument of ignorance,'" probably after cast iron established confidence as a pressure pipe. Agricola makes no mention of cast iron pipes, although he shows three-legged pots of cast iron. Ranselli, about the same period, describes a hand mill of a portable character, whose casing, he says, is made of iron, and its form and ornamentation are such that there is little doubt it was made of cast iron.

Peter Maurice, a German engineer, in 1582 erected, under the arches of London Bridge, 16 pumps, 7 inches in diameter and 30 inches stroke, driven by a water wheel, and these were of cast iron, flanged at their lower end, bolted to a valve chest.

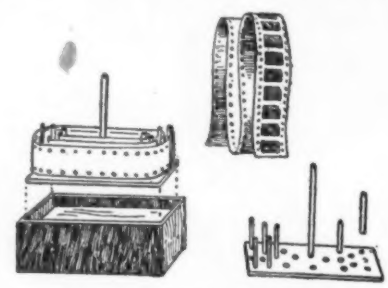
In 1835 it was estimated that over 1,000 miles of iron pipe were in use in the various systems of London water works, the first iron pipes having been laid 1746. Later on we find that cast iron pipes, 9 feet in length and 15 inches in diameter, with ball and socket flexible joints, were laid by James Watt across the Clyde for the conveyance of water to Glasgow, and another of the same size in 1818, and a little later on another of similar construction of 36 inches diameter.

Contemporary with the history of cast iron pipes in America is Peter Adams, a moulder and core maker, born in Millville, N. J., in the year 1833. His grandfather, James Adams, was a soldier in the revolutionary war. His father, Mark Adams, was born in 1789, and was a moulder and core maker at Weymouth, N. J., where he was engaged on the first cast iron pipes made for the city of Philadelphia, from designs and under the instruction and inspection of Frederic Graff, first, who was the then engineer of the Philadelphia water works, and father of the later Graff, who succeeded him in office. The first pipes made for Philadelphia were for the pumping main, of 16 inches diameter, delivering into the reservoir, the distribution still continuing throughout the city through wooden pipes. These pipes were cast direct from the melting of native bog ore, and the process was about as follows: In the beds where pigs were usually run were moulds for pipe, which tapped the flow from the furnace until one pipe was complete, then on to another mould, and so continuing for as many pipes as were planned for that pouring, using the surplus from the pipes for pigs as usual. The proprietor of these furnaces at Weymouth was a Mr. Richards, a native of the city of Philadelphia and its mayor at that time. After this, Mr. Adams thinks that the first pipe made at Millville, N. J., was about the year 1830, the inspector for which, under Mr. Graff, he remembers as one Louis Ort, who "was a good fellow enough, but inclined to be very particular unless he got one or two glasses of whisky before beginning his daily inspection, in which case it was very seldom that he would reject a good pipe."

The first pipes made at Millville, as at Weymouth, were from the product of the bog ore furnaces, and at that time, of course, cast upon their sides, a series of gates, six or eight in number, used for running the iron from the furnace into the pipe moulds, which, at the proper time, were cut off and the flow of iron continued to another series, or to the pigs, as the case might be. As time went on, and the demand for cast iron pipes increased, and sentiment ripened against using the melt direct from the ore, the proprietor of the Millville Works, David Wood, designed and constructed special foundries for their manufacture. The original proprietor of the Millville Iron Works, as before stated, was David Wood, a brother of R. D. Wood, who succeeded him and who afterward added to his pipe works from time to time until their production became the largest in the country.

DEVELOPER FOR FILMS.

ONE of the inconveniences of strips of films is that connected with development. It is either necessary to cut them in order to allow them to enter the tray, or else it requires great experience to cause them to pass through the bath properly. The small developer which we figure herewith solves the difficulty. It suffices to fix the strips around pegs, the emulsioned side outward,



DEVELOPING DEVICE FOR FILMS.

and to immerse the whole in the gutta percha trough containing the bath.—Le Monde Illustré.

PHOTOGRAPHIC WASTE MATERIAL AND WHAT TO DO WITH IT.*

IT would take but a sorry detective to discover the presence of an amateur photographer in any household his calling might lead him to be interested in. Every possessor of a camera is also the owner of vast treasure, in the way of glass, and his dwelling may be likened to a cross between a marine store and a crockery warehouse after it has been invaded by the proverbial member of the bovine species.

His friend looks in on Sunday evening and finds him piously engaged with a biblical treatise, a state of things which is sadly belied by scraps of P. O. P. scattered on the floor, and other telltale indications.

Undoubtedly spoiled negatives form the greatest part of the unsalable matter which litters his abode. I shall, therefore, consider these first. The uses to which a ruined negative may be put are manifold. Cut down to 3¼ inches square and the films cleaned off, they make excellent cover glasses for lantern slides. Another use for them in the same popular branch of photography is the following: If, during development, you see that your negative is spoiled through uneven density, excessive overexposure, or what not, expose it to the light and allow it to blacken all over. Now sealing-wax a needle to a penholder, and by means of this little tool you can easily manufacture diagram slides from your darkened film (white lines on black ground).

Take a spoiled negative, dissolve out all the silver with a solution of potassium ferricyanide and hypo. Rinse, dry, rub with sandpaper, and you will have a splendid substitute for ground glass.

Remove the silver in a similar manner from another negative, but this time wash thoroughly. Squeegee down on this a print, and an opaline will be your reward. From such an opaline, by cementing on a few more glasses, a tasteful letterweight may soon be made. Another way in which very thin negatives may be utilized appeared in these columns some months ago. It is this: Bleach them in bichloride of mercury, back them with black paper, and positives will result. Old negatives also make good trimming boards, the film preventing a rapid blunting of the knife, and they may be successfully used as mounting tables. Clean off the films, polish with French chalk, and squeegee your prints thereto. When dry they may be removed and will have a fine enameled, if hardly artistic, appearance. Many other uses for them may also be found if the amateur is at all ingenious.

Users of pyro, instead of throwing the old developer away, should keep some of it and allow it to oxidize. A thin negative, if immersed in this for a few minutes, will be stained a deep yellow all over, and its printing quality will be much improved.

Old hypo baths should be saved, and, when a sufficient quantity of silver is thought to be in solution, reduced to recover the metal.

Printing paper of any sort is another great source of waste, especially to the inexperienced photographer. Prints are too dark or not dark enough to successfully undergo the subsequent operations. Spoiled material of this kind, however, is not without its uses in photography. Those who swear by that unreliable combination, yclept the "combined bath," will find that scraps of P. O. P., or any silver paper, are necessary to start the toning action.

Spoiled matt surface P. O. P., bromide paper, or platinotype should be allowed to blacken all over. Here we have a dead black surface useful for many purposes. A leak in the bellows when out in the field; repair it temporarily by moistening a piece of matt P. O. P. and sticking it on; the gelatine will cause it to adhere. These papers may also be used to back plates, platinotypes, of course, requiring some adhesive mixture to make them stick.

In every photographer's possession there will be found a small percentage of stained prints. Instead of throwing these away, you may often turn them to good account in the following manner: Take a large piece of cardboard, some mountant and the prints. Now proceed to tastefully mount them so that the corners of some overlap, arranging in every case to hide the stain. If you have gone properly to work, you will have an artistic mosaic. Now wash round with Indian ink, or paint a border of leaves, and the whole thing will form a very nice birthday gift to a friend. Little "tit bits" trimmed from a stained print are also very useful to mount on correspondence or invitation cards.

Keep the stiff bits of cardboard between which your printing paper is packed. They are useful in many ways—from opaque cards in the dark slide to partitions between negatives in the storing boxes.

Plate boxes are useful to store negatives in. Before doing this, however, each negative should be incased in a paper envelope. Hundreds of these latter may be quickly manufactured; cut out the pattern and get a juvenile to paste them for you at so much a score.

In short, nearly every waste product has its uses, even the brown paper in which your camera was packed. This makes a good paste-down tint for mounting platinotypes upon.

There are, I know, a few amateurs with whom money is a plentiful commodity, and these can afford to be wasteful; but the great majority have to be careful with their cash, and to these economy means everything. Then there is the pleasure of knowing that you have obtained the maximum of success with the minimum of waste.

*By R. A. Hamblin, in the Photographic News.

CONVERTING SLUDGE INTO FUEL.

WORKMEN are now engaged at Rotherhithe in erecting machinery which, when in proper running order, is expected to revolutionize the methods of disposing of the more than two million tons of sludge that the main drainage committee of the County Council have to dispose of annually, says the Pall Mall Gazette. Before three months have passed, the municipal authorities of most of the large towns in the United Kingdom, together with the experts on matters connected with sanitation, are to be invited to witness the "trial trip" of the machinery, and if the results of experiments already made on a comparatively small scale are borne out in the greater experiment that is to be made, it is said that one of the greatest difficulties with which the authorities of most cities have to contend will disappear. Instead of a costly work, which it undoubtedly is at present, the doing away with the sludge will be converted into a profitable undertaking for the County Council.

Some years ago it was believed that the sludge of London possessed great value as a fertilizer, but those whose business it was to attend to its disposal found it quite impossible to get it taken up in sufficient quantities to be of any use to the County Council; and despite the enormous cost for steamers and their maintenance, it was found that to take it out and dump it into the North Sea fifty miles from shore was in the end the least expensive and most expeditious method of getting rid of the refuse.

The London County Council maintains a fleet of six sludge vessels, each capable of carrying a load of close upon one thousand tons to sea. The total number of trips made by these steamers last year was 2,176, and the cost of working the vessels came to more than £27,472. They are insured for £120,000, at an annual premium of £2,400. These expenses the new arrangement is expected to save, and at the same time the belief is that the County Council will be left in possession of an amount of fuel estimated at anything up to 700,000 tons per annum.

Leaving beaten tracks, investigators have for some time past been experimenting to convert the sludge into fuel, and the results obtained with comparatively moderate quantities, it is said, have led those interested to believe that all of the millions of tons annually dumped into the sea can be made, at virtually no cost, into good burning furnace fuel. When these experiments were completed those interested gave orders for the setting up of a large plant in Rotherhithe, and the work is now rapidly approaching completion. At the public trial of this machinery some half a hundred tons of the sludge brought from Barking is to be converted into fuel blocks by what is called the "Henry" process of sludge treatment. This process, briefly described, is as follows: The sludge, which, taken in large quantities, contains about 90 per cent. of moisture, would be treated by Hencke-Cunliffe machinery. It is pumped straight into machinery consisting first of two enormous hollow cylinders. These cylinders are heated internally by hot air, and being close-geared and revolving slowly, they are said to film the sludge on their face at about the thickness of a sheet of blotting paper. By far the greater part of the moisture is evaporated at one revolution of the big cylinders, and the nearly dried sludge is automatically scraped off, and falls into jacketed pans, which, like the cylinders, are heated by hot air and fitted with slowly revolving sweeps that stir and carry the sludge along until the whole of the acquired amount of moisture is evaporated. Then the sludge is automatically discharged upon machinery that presses it into fuel blocks ready for consumption in furnaces.

LEFTOMANIA.

ABSENT-MINDEDNESS would seem to be on the increase, says the Humanitarian. This is a disease not, indeed, to be found described in the pages of the British Medical Journal, but one, nevertheless, clearly defined under our present social conditions. To some extent kleptomania, with which we are all conversant, is its complement. The Great Eastern Railway auction is a wholesale example of the extent of the disease. Two thousand umbrellas, half that number of walking sticks, 600 hats, bicycles, perambulators, and feather beds were unintentionally abandoned by their owners during the past twelve months. Leftomania is recognized at all theaters, and due provision is made for the failing.

ENGINEERING NOTES.

For some years past a solitary dining car has been running on the Rohil-Khand and Kumaon Railway. The example has now been followed on another line, a dining car having been recently put on the Bombay-Calcutta limited mail.

The Paris correspondent of The Times gives particulars of the trial trip at Mantes of the electric locomotive devised by M. Heilmann. The train was composed of twelve carriages and a luggage van, and carried 250 persons, and weighed about 150 tons. The object of the trip was not to make a trial of speed, and the train journeyed at the rate of only 18 miles an hour. The experiment seems, however, to have been considered a great success, and testimony is borne to the ease and regularity of the movement of the train. Great things are hoped from this invention, no less than the conveying of a train weighing 300 tons at a speed of 62 miles an hour being looked forward to.

In the latest annual report of the Chief of the Bureau of Steam Engineering the following note occurs: "The improvement in machine tools in the last twenty years has been so great that private builders who are at all enterprising throw away old tools, although in good condition, to give room for the latest and best. One large firm, with what was considered one of the best plants in the country, recently broke up good tools valued at $40,000, because they were becoming antiquated, and expended $200,000 for new ones of the latest pattern to replace them." It is by keeping themselves entirely up to date that the Americans are able to produce machinery of all sorts at a greater rate and more economically than other nations. The last sentence, coming as it does from The Engineer, of London, is significant.

Various schemes have been proposed for the last quarter century for the use of the ruins of the Cour des Comptes, on the Quai d'Orsay, in Paris, so long a memorial of the "Commune," and at one time it was arranged to convert the ruins into an imitation of the South Kensington Museum. But utilitarianism has finally gained the prize from decorative art. The Chamber has agreed, says Architecture and Building, to a proposition for the concession of the block to the Compagnie d'Orleans, in order to erect on the site a terminus which will be more central than the present building on the Boulevard Montparnasse. The interests of the International Exhibition of 1900 must have had an effect on the voting, for some years ago a railway terminus in such a position would not have been tolerated.

J. J. Holtzapffel, in a paper recently read before the Society of Arts on the uses of the sand blast, alluded especially to the value of the process in sharpening files and the superiority of the process, the sand-blasted file doing twice the work of the ordinary file in the same time, this superiority being now so fully recognized that 240,000 dozen files are so prepared in Sheffield yearly. They can also when worn be resharpened over and over again, without grinding out the old marks, for about 2½ per cent. of their value. He also spoke of the efficacy of the blast in removing every trace of scale from iron castings, so that the finest tools may be applied at once to the metal, and of its usefulness in refacing grindstones and emery wheels, cleansing bicycle tube surfaces before brazing, granulating or frosting electric plate, gilding metals, gold and silversmith's work, and jewelry, and many other purposes suggestive of a widely extended field for the sand blast in metallurgy.

Some interesting statistics of the world's output of steel were laid before the last annual meeting of the German Iron and Steel Institute, from which it appears that the production of steel ingots during the past three years was as follows:

	1894.	1895.	1896.
United States	4,426,000	6,143,000	5,600,000
Germany	3,786,000	4,100,000	4,900,000
United Kingdom	3,160,000	3,312,000	4,200,000
France	818,000	876,000	1,128,000
Russia	695,000	785,000	900,000
Austria-Hungary	649,000	732,000	869,000
Belgium	405,000	455,000	598,000
Sweden	167,000	194,000	250,000
Spain	70,000	65,000	105,000
Italy	65,000	60,000	60,000
Canada	40,000	40,000	40,000
Totals	14,274,000	16,753,000	18,650,000

In addition to the above, about 250,000 tons of crucible steel are manufactured, the United Kingdom producing about 100,000 tons, the United States about 70,000 tons, and other countries the balance, says The Colliery Guardian.

Some of the engineering difficulties encountered by those engaged in the construction of railways in Africa are pointed out by a correspondent of The London News, the principal one being the lack of water. Thus, at Wadi Halfa, the engineers' headquarters in the Soudan, some 12,000 gallons are daily collected and thence sent forth to the various stations, the most distant being 60 or 70 miles. The water is carried in iron tanks, each tank filling a truck. Every train that starts from Halfa laden with materials, such as rails, sleepers and other gear, has no less than fifteen of these trucks, which, by the exigencies of the situation, are loaded with water alone. The quantity of water thus conveyed, large though it is, suffices only for drinking purposes. On this account it has been considered a matter of great good fortune that the officers in charge of this work have now discovered that by boring at a point in the desert some 75 miles or so out from Halfa water may be obtained at a depth of about 56 ft. As might be expected, much speculation has been aroused by this flow of water more than 1,000 ft. above the level of the Nile. Among the many theories on this subject, that which obtains most favor among geological and other experts is this, namely, the existence under the Nubian desert, beneath a flooring of rock of varying thickness, of an immense reservoir containing a practically unlimited supply, and that digging at any one point would be rewarded with success, the question being merely one of depth. Another attempt is to be made to find water 50 miles further on.

ELECTRICAL NOTES.

It may not be generally known that in the city of Brussels, in Belgium, a system of electrically operated clocks was installed in April, 1857, at which time 100 clocks were installed, using the Nolet system. With some modifications, says The Electrical World, they have been in operation ever since then.

An exchange reports that in an examination that was made of some "electric belts" sold by a street fakir, it was found that beneath a strip of gauze was a layer of dry mustard. When the wearer perspired a little, the mustard was moistened and set up a burning sensation, and the deluded victim believed a current of electricity was passing through him.

An isolated electric plant was recently installed in a large tea firing or curing establishment in Yokohama. This establishment employs 2,000 people, who clean and sort the tea by native fan blowing and sifting machinery, after which it is taken to the firing rooms, containing 1,500 pots, set in brickwork and heated by a slow fire, the tea being stirred continuously by the coolie who attends each pot, the work going on day and night during the busy season.

United States Consul Child, at Hankow, has informed the State Department that an electric light plant has been established in that city, which is the capital of the most exclusive and hostile province in China. It was in this province that the Chinese a few years since refused to allow telegraph poles to be erected, and the missionaries have encountered there more opposition than at any other place in China. The public buildings have adopted the new light, and all prejudice is giving way to the new invention.

One of the many remarkable things in Australia is the overland telegraph from Port Darwin to the south of the continent, which was completed in 1872, says The Electrical Review. Almost the whole 2,000 miles of its length were through uninhabited country—much of it a waterless desert. The wooden poles were prepared at the nearest available places, but some had to be carried 350 miles, while the iron poles were taken an average distance of 400 miles by land. Over 2,000 tons of material had to be carried into the interior, and the total cost was $1,850,000.

A charter was granted by the State Department of Pennsylvania on November 8 to the Washington, Westminster & Gettysburg Electric Railway Company, which will build a line fourteen miles long, from Gettysburg to the State line. This is the company which intends to build a line to the national capital. The capital stock is $400,000, and the officers are: President, James B. Colgrove, Washington; directors: Samuel S. Bushman, Charles A. Trastel, and Henry C. Little, Gettysburg; Henry A. Cady, Washington; Charles H. Duttera and John A. Shore, Littlestown.

The lighting plant of the new limited trains of the Lake Shore & Michigan Southern Railway consist of a 30 horse power compound Westinghouse engine, with a 7 by 7½ inch cylinder giving 400 revolutions with steam at 80 or 90 pounds. The engine is direct connected to an 18 kilowatt Westinghouse compound multipolar generator of 120 volts, operating in all about 300 lamps of from 12 to 20 candle power each. The outfit is placed at the forward end of the baggage car, steam being supplied from the locomotive by a system of pipes and flexible rubber couplings. The cars are connected by a flexible plug coupling, and a similar plug is arranged to supply current from the city circuits at stations where a change of engine is necessary.

Three-phase current transmitted from the water power plants of Sacramento and San Joaquin Rivers is being used to operate milling machinery in Fresno, Cal. In the case of the Sperry Flour Mill a 150 kilowatt General Electric synchronous motor, running at 600 revolutions per minute, is operating the various machines, says Engineering News. In another mill, which is the largest flour mill in the United States using electricity as a motive power, three General Electric three-phase induction motors of 75, 30 and 20 horse power are belted to the mills, cleaners, etc. These motors are provided with recording meters and are run only when the machines to which they are connected are needed, thus effecting a saving of about 15 per cent. in power.

According to The Pall Mall Gazette, the movement toward an introduction of automobile cabs and omnibuses has reached Berlin, and soon a number will be in full action there. Some of the leading men of the electric establishments, among others Mr. Rathenau, the director of the Berlin Electric Works; Mr. Borsig, head of the largest locomotive building establishment; and Colonel Budde, the chief of the railway department in the "Genaistal" of the Prussian army, have founded a company for motor cabs and omnibuses in the great towns of Germany, and they will begin their action at once in Berlin if the president of police does not put a veto in their way. The Berlin pavement, mostly macadam in the principal thoroughfares, is well fitted for motor cabs, and there is every hope of success for such a company.

Nearly every electric road has one or more cars that are slow. They may be of a comparatively primitive type, as far as the motors are concerned, but the trouble can usually be cured by rewinding the armatures and fields, or by a rearrangement of the controlling apparatus, says The Electrical World. The presence of a single slow car will make itself felt very quickly over the whole line upon which it runs; and the quicker such a car is sent to the shop and "speeded up," the better will it be for the interests of the company operating it. On one road it has been the custom to run such cars only when the traffic was heaviest, probably with the idea that as the cars could not travel fast at such times, the slow car would not cause much trouble. The reverse of this was found to be the case. The slow car was slow in getting up to speed after stops, and caused great delay by that action. These cars are now operated only at night, when the motormen are naturally inclined to wild running. The slowness of the car acts as a check in this direction. Thus some use is made of the slow cars, but in spite of this they are being put into the shop to have motors rewound as fast as possible.

MISCELLANEOUS NOTES.

France has 83,465 public schools, an increase of 223 within a year; 15,909 of them are under clerical control. The number of teachers is 151,563, the number of pupils 4,580,183.

The management of French state railways has obtained permission of the minister of railways for the construction and reconstruction of a number of railway passenger carriages in which all parts formerly manufactured of brass, copper and iron, with the exception of axles, wheels, bearings, springs, brake gear and couplings, shall be made of aluminum. The weight of a coach with these fittings is one and a half tons less than that of an old style of carriage, and as an ordinary train in France consists of twenty coaches, says Aluminum and Electrolysis, the weight of the train would be reduced by thirty tons, which would mean a considerable saving in working expenses.

The seat of the Japanese matting industry is the town of Sa'kai, about eight miles south of Osaka, and having a population of 4,800. According to a consular report, the rugs are made principally of jute. The number of people employed in the manufacture is about 9,600, mostly children, girls and boys between seven and sixteen years old. There are 2,400 looms in 800 houses, giving an average of three looms to each house, and each loom is attended by four persons. The warps of the rugs are of cotton, but the weft is thick jute yarn, and the filling thin jute yarn. The designs are mostly Turkish and imitated Persian. The price ranges from 4 to 6 cents per square foot, according to the quantity of material used. When the weavers are fully employed in filling orders, they can turn out 4,800 square yards daily. The yarn used in this manufacture is principally imported from Calcutta.

The lack of efficiency in the ordinary belts is due principally to the air cushions between the belt and pulley, causing slippage. In the pneumatic pulley this air is entirely eliminated by means of perforations all around the face of the pulley. These perforations are regularly placed in rows parallel to the axis, the perpendicular positions of the perforations of each row alternating with those of the next. The belt closely grips the face of the pulley and operates, therefore, without the loss attending pulleys permitting an air cushion between the belt and the face. The use of this pulley, it is claimed, enables the use of a smaller and looser belt, owing to the elimination of nearly all slip, which, with the ordinary pulley, is said to be equivalent to a loss of about 10 per cent. in power. A more uniform speed can be obtained between the driver and driving element, which is an important feature in high speed work. Less tension on the belt means less oil in the bearings, and smaller belts mean smaller first cost.

The use of salt water by the New York fire department is again being discussed by a commission made up of Fire Commissioner Sheffield, Chief Bonner and Foster Crowell, M. Am. Soc. C.E., says Engineering News. Boston already has pipes laid for bringing in sea water for use in extinguishing fires, and Buffalo, Cleveland, Detroit and Milwaukee can use water directly from the lakes in similar cases of emergency. The plan is approved by the insurance companies of New York, and one prominent insurance officer says that a reduction of 5 per cent. in insurance rates would be possible on a line of 10 in. pipes connecting with the North River, or within 500 ft. of a hydrant connected with these pipes. Such a pipe system would vastly extend the usefulness of fireboats by making them effective at long distances from the shore line. The saving in water and damage by fire would more than offset the first cost. As showing the value of the property to be protected, the statement is made that the aggregate value of buildings and property between Chambers Street and Fourteenth Street is at least $500,000,000.

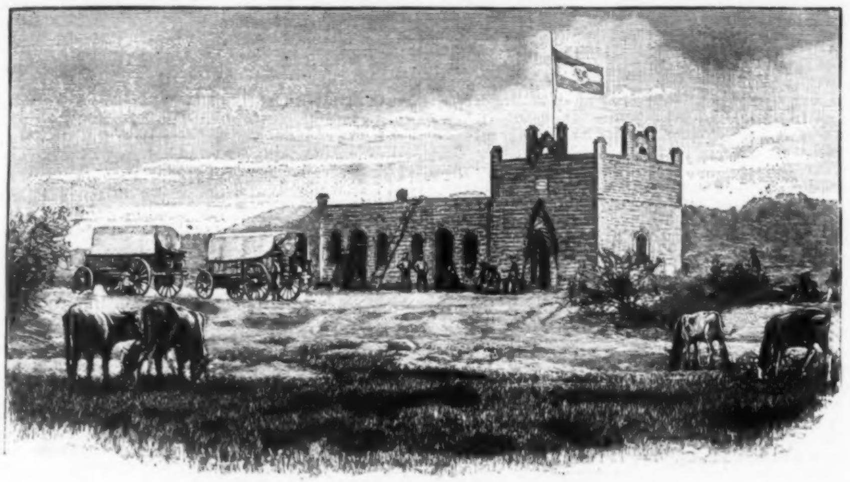
The Boston Transcript says: "Comparisons between the fire in London recently and the conflagration that swept the city in 1666 are natural at first glance, but in reality there is not the slightest resemblance between the two. The recent fire was diminutive in its proportions as compared with what will always be known in history as 'the great fire of London.' The conflagration which began September 2, 1666, and raged for four days, swept over 436 acres, destroyed fully 100 churches and public buildings and 13,200 dwellings. It rendered 200,000 people homeless. A considerable section of the city burned over was practically a survival of medieval London, of dark and narrow lanes and houses that simply stood because they had got into 'the habit of living.' The conflagration was, in fact, a purification by fire. The recent fire was confined to a few acres in the business center of London. The property loss, taking into consideration the scarcity of money two centuries ago, was not as large in the late fire as in 1666, nor are any considerable number of people rendered homeless. The buildings destroyed were business blocks. While some of these structures had been built or modernized within the last fifteen years, more of the blocks resembled the older style of business buildings wiped out by our own fire of 1872, with the addition of a frowsy dinginess of aspect due to the foggy and grime-spreading atmosphere of London."

An account of the organization of beet sugar factories in Germany, in the Consular Reports for November, is interesting as giving an example of the successful application of the co-operative principle. Out of the 399 factories now in operation, nearly half are stock companies, in which the majority of the shareholders are beet growers. These include not only most of the largest factories, but also the most prosperous.—An abstract of the Mexican Annual Statistician for 1895, just published, shows the population of the republic to be 12,578,861, and the surplus revenue nearly two million dollars (silver). There are 24 museums, 68 libraries, with 512,529 volumes; 39 scientific societies, and 454 periodical publications, including 44 dailies and 185 weeklies.—From an interesting description of a visit to the great salt wells in the province of Sze-Chuen, in Central China, we learn that the majority of the wells are from two to three thousand feet deep, and that the brine is evaporated by means of jets of natural gas. At one place the brine is carried five miles by a veritable pipe line (bamboo conduits) to the boilers. The wells are said to have been in operation two thousand years.

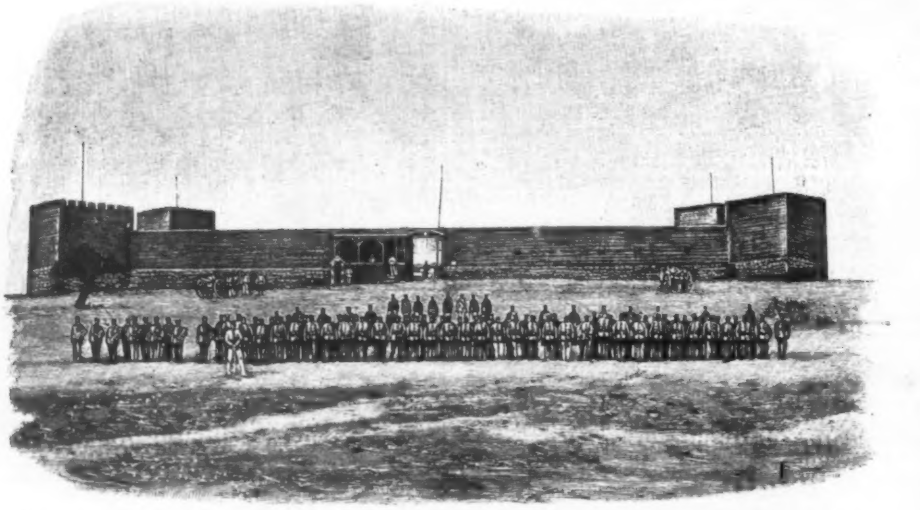
PICTURES OF SOUTHWEST AFRICA.

WINDHOEK, the capital of German Southwest Africa, is several hundred miles from the coast, and now can be reached only by a fatiguing journey of several weeks in heavy oxcarts, but next year a harbor is to be built at the mouth of the Swakop River, and then the railroad will be continued from there in the direction of Windhoek; the governor-general of the protectorate, Major Leutwein, has lately visited Germany on business connected with this project. The location of the place is delightful; the plateau on which Windhoek stands is bordered on the south by the Awas Mountains and there are heights on the north and east, and the atmosphere of the dry steppes is so clear that all characteristic features of the landscape stand out sharply like silhouettes. It is exposed not only to storms of the elements, but also of the different tribes; lying as it does between the land of the Hereros and the land of the Hottentots, it was always an "apple of discord" until Jan Jonker, a chief of the Orlamhottentots, laid a firm hand on it. In 1889, however, he was murdered by the tribe of Henric Witboy and the place was left free, but being of strategic importance, it was occupied by the Germans and made the capital of their colony. Their choice of a location was facilitated by the presence of several hot springs that could be utilized for the irrigation of gardens, if, as was to be expected, colonists should settle in the neighborhood. This expectation was soon realized, for at Klein Windhoek—so named for the sake of distinguishing it from Gross Windhoek, from which it is only half an hour distant—huts of industrious German pioneers rose about the half-ruined buildings of the Rheinische Missionsgesellschaft which once had possession of the place. Many have succeeded in wresting a livelihood from this wild and not very fertile land, but others have had to give up the hard struggle, for all are not fitted to bear the hardships that must be endured by colonists in a new country.

But to return to Windhoek; the fort, a solid structure of broken stone and brick, makes quite an imposing impression. It has a court 168 ft. long and 65 ft. 7 in. broad, surrounded by a high wall along the inside of which are arranged the rooms for the garrison. This outer wall is 19 ft. 8 in. high in some places. The fort is strongest at the four corners, which are provided with battlemented towers that could still offer a strong resistance, even if the court were taken by a hostile party, which is extremely unlikely to occur. North of the fort is a long row of buildings placed close together. These include stables, workshops, the prison, guardrooms, police station, officers' dwelling, the messroom and the house of the governor-general's secretary. A little below these lies the house of Major Leutwein, with its stables and pretty garden, and about 300 ft. farther down the mountain side are the government buildings and dwellings of several officials. It will soon be necessary to add to the number of business houses now possessed by Windhoek, as the town has gained considerable commercial importance. The natives, Hill Damaras, with some Hottentots and half breeds, live in square structures with walls of mud covered with clay and roofs made of reeds.



STATION HOUSE AT GROSS BARMEN.



COMPANY OF TROOPS OF THE PROTECTORATE (WITH LIEUT. EGGERS) IN FRONT OF THE FORT AT WINDHOEK.

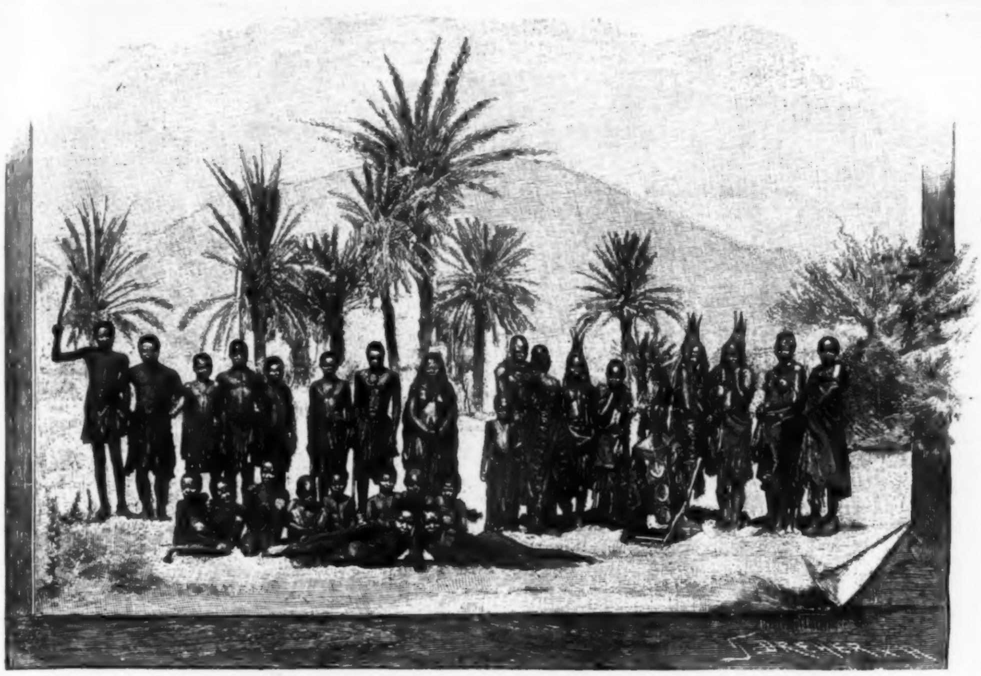
A strong station house has lately been built at the village of Otjikango or Gross Barmen, which lies on the great highway that runs from the mouth of the Swakop River through Otjibingwe to Windhoek. As early as 1884 a way station was founded here, near which are a number of hot sulphur springs, which seem to be specially efficacious in the treatment of skin diseases. A special charm is given to the spot by a little group of date palms that were raised from the seed by the first missionaries. These palms seem to thrive well, although their fruit ripens only in most favorable years, and even then its aroma cannot be compared with that of the fruit cultivated in North Africa. Otjikango is of historical importance on account of the numerous battles that have been fought, even recently, in the place itself and in the immediate neighborhood between Hottentots and the Hereros. The inhabitants of Gross Barmen belong to the Ovambandjerus tribe, and they wandered down from the north at the same time as the Hereros, with which race they have become blended.

The Hereros are the most powerful tribe in the protectorate and are looked upon as the conservative element that must be gradually trained and made useful for the common good. They are a fine race of men, with many excellent qualities, but, on the whole, their character is the same as that of the South African Kaffir. New arrivals often consider the Herero a stupid savage, but they soon learn from experience that he is, in his own way, a very shrewd fellow, and what seems like stupidity is only a certain slowness with which he follows the European's line of thought. The Hereros are cattle-raising nomads occupying the central part of the protectorate. Cattle, in fact, constitute their chief possession; they are devoted to them and in caring for them will even work—something they never do willingly. Milk is their chief food. A real Herero is very loath to sell his cattle, and never will part with any but the least valuable animals; he, like the Matabele, prefers to let his dearly beloved cattle die of old age, rather than let them go. Lately the rinderpest has made sad havoc among these cattle, of which some Hereros own many thousands, so that they are very rich, and it is impossible to say where the devastation will end. Christianity found a foothold among these people long ago, but comparatively few have been converted to this faith, because the Hereros are strongly attached to their own peculiar manners and customs. The dress of the Herero woman, who is not uncomely

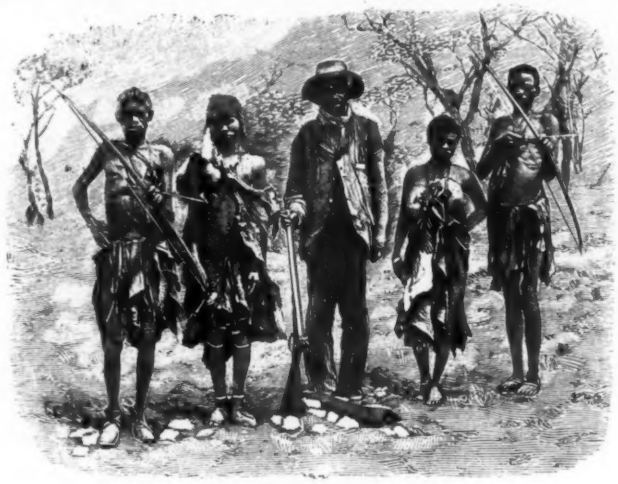
HENRIC WITBOY AND HIS FAMILY.

CHIEF NICODEMUS AND SEVERAL OFFICERS

in her youth, is most original. On each leg she wears an ornament which consists of several strings of iron beads, twenty or more, according to the wealth of the wearer; and she wears an apron and a sort of bodice or corset composed of strips of leather on which little disks made of ostrich egg shells or balls made from a sweet-smelling root are sewed, and over her shoulders hangs a mantle that is fastened in front. Chains of iron beads are wound around her neck and the upper parts of her arms, while cuffs consisting of coils of strong iron wire cover her wrists. The queerest part of the costume is the headdress worn by married women, which is not unlike a bat's wing in shape. From the back of the cap part of the headdress hangs a broad decoration consisting of strings of leather on which are strung little iron tubes or long beads, and these strings are held together by cross strings; this decoration hangs to the knees. The weight of jewelry carried around by a wealthy Herero woman may easily be estimated to weigh fifty pounds. She is not without a certain charm as she walks along with her mantle thrown coquettishly over her bare shoulders, the stiff corset holding her well shaped body straight and preventing any violent movement. She is the picture of natural strength and proud self-consciousness moulded to a native fashion.



HERERO MEN, WOMEN, AND CHILDREN IN GROSS BARMEN.



BUSHMEN.

Another rather wildly clad race in South Africa are the Bushmen, who still occupy large districts in South Africa, broken up into small bands. They may have been the aborigines, but in Southwest Africa they now resemble the Hottentots so strongly as to be almost indistinguishable from them. They go almost entirely without clothing; an apron that sometimes resembles bathing trunks and sometimes hangs down loose constitutes the only article of wearing apparel for most of them, but the older and more prosperous men and women sometimes wear a mantlelike shoulder covering of leather or fur, the fur being worn next the body. They hunt with the primitive weapons like those formerly used by the Hottentots, the bow with poisoned arrows and the boomerang. The poison for the arrows is taken from the juice of the euphorbia or from certain insects or snakes. They are a miserable race, and as they have no cattle, they live on what they get by hunting and on wild fruit, and when brought in opposition to the Hereros really have no rights.

The yellow Hottentots living in the south of the land present a strong contrast to the Hereros. As a tribe they are lazy, careless, fond of drink; the former "prophet," Henric Witboy, is inseparably associated with their history. He wanted to renew the glory of his tribe, who were once the masters of the Hereros, and the latter found him an enemy that was not to be despised. Although he was overpowered many times, he always found new ways of getting on, until he finally came into conflict with the Germans. The authorities warned him many times to give up his warlike attitude and to acknowledge the German protectorate, but he paid no attention to them, even when offered the most favorable conditions, and in 1893 he planned an attack on Windhoek, which he was prevented from making only by the arrival of a reinforcement of German troops. The subsequent events are well known; it was not until 1894 that Witboy's force was compelled to capitulate in Naukluft. Witboy is unquestionably a remarkable, energetic man, exerting the greatest influence over his fellow tribesmen, and at the same time he is cunning to the highest degree. His countenance displays a certain sullen determination. Our engraving of him and his family is a reproduction of a picture taken at Gibeon, the home of his tribe, where he and the remainder of his people were taken as pensioners of the government. The women standing beside him are his daughters, and in front of him sits his son Samuel, with his wife and children. Last year, at the time of the insurrection of the Khaus Hottentots and the Ovambandjerus, Witboy rendered the troops valuable services.

The Khaus Hottentots, who had been placed on a reservation in the south of the protectorate, moved north and seized Gobabis. They were joined by discontented Ovambandjerus, under their chief Kahimema, who had already, in 1891, made an attack on Gibeon during the absence of Witboy. But the real leader of this expedition was Nicodemus, the son of the oldest sister of old Maharero, the great chief of the Hereros. When the old chief died the honor was conferred upon Samuel Maharero, who was friendly to the Germans, and Nicodemus withdrew in anger from Okahandja, to pitch his tents in the land of the Ovambandjerus. By an energetic action of the troops of the protectorate, assisted by Witboy and his tribe, the insurrection was quickly suppressed, after a bloody battle, and the culprits had to endure a severe punishment.—Illustrirte Zeitung.

HERERO PRISONERS WITH CHIEF KAHIMEMA, WHO WAS AFTERWARD SHOT.

THE LIPARI ISLANDS.

By E. O. HOVEY.

THE beautiful group of islands known as the Lipari or Æolian Islands lies within easy reach of Messina by way of Milazzo, but rarely does a tourist make his way thither, and most of the foreigners who do visit the islands are geologists who wish to study the volcanic phenomena which are so clearly shown there. Seven islands, Vulcano, Lipari, Salina, Filicuri, Alicuri, Panaria and Stromboli, together with ten islets and numerous crags, form the group. Of these Lipari is the largest and most populous and is best known to the outside world, because it is the source of the pumice stone of commerce. The mountains of this material form a very striking feature in any view of the island from the east or northeast. The scenery of the islands is varied and beautiful, the villages are quaint and picturesque, and the people interesting, but the object of the present communication is to give a brief notice of the geology of the islands and an account of the ascents of Stromboli made on October 27 and 28, 1897, by Prof. H. F. Reid, of Baltimore, and the writer, rather than to dwell upon scenery or political history.

All the islands appear to be purely volcanic in origin, and all except Stromboli rise as more or less distinct cones from a depth of about 1,000 meters below the level of the sea, the cones of Vulcano, Lipari and Salina overlapping one another so as to form a composite series. Stromboli's base may be said to be at the 1,500 meter depth, judging from the contour map of the Italian government as published in Cortese's geological description of the islands. Stromboli has been known as an active volcano throughout all human history of this region, and Vulcano was the site of the forge of Vulcan or Hephæstus in ancient mythology. According to the historian Orosius, the island of Vulcanello, which is connected with Vulcano by a narrow isthmus, was formed by a series of eruptions about B. C. 204; and according to the same authority and Pliny a violent eruption occurred in B. C. 126, which broke up the island of Panaria into the group of islets now located on its site and destroyed part of it. No other eruptions on the islands have been recorded up to 1888, when Gran Cratere on Vulcano burst into a violent eruption of cinders and ashes, destroying the sulphur works which were operated in the bottom of the crater by an enterprising firm of Englishmen, and spreading a mantle of volcanic debris over a large part of the island and far beyond it.

The islands show several typical examples of the formation of successive craters along a line of fracture or weakness in the earth's crust, the destruction of one side of one crater being a preliminary to the formation of the next eruption center. Standing on the summit of Gran Cratere, one readily sees that there have been at least four great craters on Vulcano, advancing from south to north; while Vulcanello shows three small ones advancing from east to west.

The visit to Vulcano and Vulcanello is easily made by rowboat from Lipari, and should on no account be omitted from a trip to the Æolian Islands. Landing at the Porto di Levante, one comes first upon the villa

of the proprietor and then upon some of the ruins of the sulphur and chemical works which were destroyed by the eruption of 1888. Everything has a most desolate appearance on account of the mantle of black ashes covering the ground. Some attempt has been made to cultivate the vine, but without much success, and the island is almost destitute of inhabitants, because since the eruption there has not been enough sulphur or sal ammoniac to make it worth while to rebuild the factory. The path up the cone leads one past several large fumaroles on the margin of the old crater ring surrounding the present crater. These fumaroles are surrounded by incrustations showing the characteristic lemon-yellow crystals of sulphur, and the fumes smell strongly of sulphureted hydrogen. The crater is nearly circular in form, rather more than a fourth of a mile in diameter, and two hundred feet or more in depth below the lowest point of the rim. The interior is a simple inverted cone, broken by two terraces on the west and north sides and having a ridge across the bottom which was thrown up by the last paroxysm of the eruption of 1888. The inner slope, though very steep, is not precipitous, except on the south and southwest sides, where the walls of the old crater rim are exposed. Slight fumarole action is observable in the very bottom of the crater and at several points high up on the walls. The great stream of obsidian on the north side of the cone, which is so prominent in Judd's description of Vulcano in his work on "Volcanoes," was covered to a great extent by lapilli and dust during the eruption of 1888.

To visit Stromboli, which lies twenty-two miles from Lipari, one must take a small boat with oars or sails for the journey one or both ways between the two islands, unless he is willing to spend a week on the island, for the steamer service is only weekly. San Vincenzo is the largest of the three hamlets on Stromboli and is the only one where the ordinary traveler can procure any tolerable entertainment. The village lies crowded together on the northeastern point of the island and is somewhat picturesque, like most Italian villages. A peculiar feature is the absence of four-footed beasts of burden. We did not see even a donkey during our stay on the island. Dogs and cats are scarce.

Instead of being a regular cone, as it seems to be from the sea, a glance at the map shows that the island of Stromboli is an irregular trapezium in shape, with its longest diameter from northeast to southwest. Its area is only about five square miles, two-thirds of which is under cultivation, almost entirely with the vine. Above the broad zone of grapevines comes a narrow belt of fig trees, above which is an irregular zone of tall coarse grass much used by the inhabitants in making fences for their vineyards. The upper limit of the grass is about 450 meters above sea level, as determined by Dr. Alfred Bergeat, of Munich, whose exhaustive treatise on Stromboli, published in 1896, should be read with care by those who wish detailed information about the island. A waste of black volcanic sand alternating with streams of lava turned red by weathering occupies the upper half of the altitude of the mountain.

Climbing to the northern summit, 918 meters above sea, one obtains a very clear idea of the volcano and its history. He sees around him extending from the northeast to the south and west the high lava walls of an old crater surrounding the present crater just as Monte Somma surrounds Vesuvius. This lava wall rises on the south to the elevation of 926 meters,* forming the culminating point of the island. Our point of observation is on the wall of an inner crater, and more than 200 meters below us on the north we can see the centers of activity forming the present series of small craters. To make this active crater, the northwestern quarter of the old crater wall was destroyed at a period antedating human history or tradition of the region.

The rim of the ancient crater consists for the most part of andesitic lava, and the steepness of the slope outside the crater on which this lava consolidated is surprising. I measured the inclination on the east side at between 31° and 32°, and the slope seems equally sharp all around. Cliffs giving partial cross sections of the cone show that flows of lava alternated with eruptions of ashes and coarse and fine lapilli in building it up. The lower parts of the old cone show that there have been periods of eruption of other and more basic lavas and the material thrown up in historic time is all basaltic in character.

As far as the writer is aware, all published accounts of Stromboli agree in assigning it constant activity. In ancient times the mountain was known as the "Lighthouse of the Mediterranean," and the beautiful rosy light reflected from the clouds of steam over the crater has often been described as one of the attractive features of a trip by water between Naples and Messina. The activity was such, however, that it could readily and safely be watched from a point near the crater, and the knowledge thus gained has contributed much to the science of vulcanology. Although molten lava could be seen in the bottom of the crater, according to several observers, when it was possible to look over the brink of the crater, all the descriptions speak of the activity as consisting merely of explosions recurring at more or less regular intervals, but the number of eruptive openings reported varied from one to seven. When Bergeat visited the mountain in October, 1894, there were four openings or craters extending in a northeast-southwest line, the largest and oldest crater being at the northeast. He watched the craters for five hours, keeping careful record of the time and character of each explosion from each opening, arriving at the conclusion that no rule could be laid down for either the frequency or the strength of the explosions. These explosions threw fragments of lava high into the air, most of which fell back into the crater from which they originated, but others fell outside to build up the cone or roll down the Sciarra del Fuoco into the sea. Such has been the usual state of things at Stromboli. No one has reported the volcano to be inactive, and only twice in the last hundred and twenty years (in 1889 and 1891) have lava streams been known to accompany an eruption.

In view, therefore, of the record of the volcano a statement of the present condition of affairs will not be without interest and some scientific value. When we visited the mountain there was no eruption in progress. The most southwesterly of the openings described by Bergeat seemed to have disappeared; the second and third were emitting copious clouds of vapor; the "old" crater was giving out but very little steam, though a great deal was coming from the top and outside of its eastern rim. The craters were wholly in the solfataric stage and had evidently been so for some time. Inquiry at Lipari elicited the information from Bartolo Nicotera, the guide to the islands, that there had been no eruption from Stromboli for about a year. An interesting phenomenon was the issuing of hot vapors from the top of the high ridge of tuff, cinders, etc., which rises 220 meters above the southern side of the new craters and is known as the "Cima dello Stromboli." Such vapors are not always rising from this high ridge when the volcano is active. The question as to whether Stromboli will ever resume its activity and again become the Lighthouse of the Mediterranean, as it was for so many centuries, is an interesting one, but one which it is useless to consider. Every other volcano has had its seasons of rest and of activity, and now even Stromboli, after centuries of ceaseless eruption, is having its period of quiet.

* This is the elevation given by the Italian naval chart. The French chart gives 942 meters, the English 3,090 feet (= 936 meters) and Bergeat determined it as 940 meters.

MENTAL EVOLUTION IN MAN.*

By R. M. BUCKE, M.D., Medical Superintendent of the Insane Asylum, London, Ontario, Canada.

ABOUT sixty years ago now, in the time of the Millerite excitement, a man who believed that the world was about to end expressed his fears to Emerson, who replied that it was really a matter of little consequence, "for," said he, "we can do very well without it." There are wise men who teach that each man creates the world he lives in, and as he gives it its substance so also does he give it its quality, insomuch that it is good or bad as he is good or bad. Be this as it may, it is certain that each one of us is of more consequence to himself than is all the outside world, be it shadowy or be it solid; be it created by each inhabitant or be it independent and self-existent. Not only so, but the essential part of each man is what we call his mind, in comparison to which the body is an insignificant factor.

The Study of Psychology.—This being granted, it would seem to follow that psychology ought to be the most interesting of all the sciences, and as a matter of fact it undoubtedly is so, though it has been greatly discredited by the imperfection of the method by which it has until very lately been studied. That imperfection is so great that it would hardly be an exaggeration to assert that nearly all the study and thought expended upon it down to the beginning of our own age has been fruitless and as good as wasted, except inasmuch as it has at last made clear the impassability of the route men have sought to follow, the route, namely, of introspection. For we might as well study the human body alone without reference to that of any other creature, and attempt in that way to decipher its genesis, development and meaning, as to attempt to comprehend a single human mind without including in our examination not only other human minds in all stages of evolution, but equally all other minds to which our own is related—that is to say, all minds other than human belonging to our kinsfolk the animals, minds which stand to-day like mileposts along the almost infinite length of the path which our mind has followed in its upward march across the immensities and eternities from its remote infancy to the present hour; minds which in a thousand faculties represent to us everywhere, in infinite sameness and variety, replicas of our own or of parts of our own, showing us, as the poet says, tokens of ourselves which we "negligently dropped as we passed that way huge times ago."

Comparative Psychology.—As man's bodily life rests upon and grows from that of countless prehuman ancestors; as man includes in his structure the heart of the reptile, the gills of the fish, as well as the forms in outline of innumerable still lower races, so is his so-called human mind rooted in the senses and instincts of all his ancestral species; and not only so, but these senses and instincts still live in him, making up, indeed, far the larger part of his current everyday life; while his higher psychical life is merely the outgrowth and flower of them.

As truly as the plant is an embodiment of inorganic matter vivified by the transmuted forces which in the non-vital world about us we call light and heat, so truly is man's mind the outcome of—the expansion and culmination of—the imperfect sensation of the worm, the rudimentary sight, hearing and taste of the fish and reptile; and the simple consciousness which, springing from these, passed to us after almost infinite ages of slow evolution and amelioration through tens of thousands of generations of placental mammals our immediate progenitors.

In the growth of mind, whether that of the race or of an individual, we recognize two distinct processes: First, the very gradual evolution to, or toward, perfection of faculties that have already come into existence; and, secondly, the springing into existence (as new branches start from a growing tree) of faculties which had previously no existence. For it is clear to the least thoughtful student that no faculty (as no organ) came into mature and perfect life at once. Hearing and sight, we are told, developed by slow degrees from the sense of touch; and in the region of the intellect conceptual life was born from ages of receptual, and that from millenniums of perceptual.

Mental Growth in the Individual and in the Race.—Let us now suppose mind growing for millions of years in the way set forth. It begins, we will say, as mere excitability; to that after a long time is added what may be called discrimination, or choice and rejection of, for instance, different kinds of food. After another long interval of almost infinitely slow advance sensation appears, and with it the capacity of pleasure and of pain; then, later still, memory; by and by recognition of offspring; and successively thereafter arise reason, recognition of individuals and communication of ideas. Concurrently with these intellectual faculties certain moral functions, such as fear, surprise, jealousy, anger, affection, play, sympathy, emulation, pride, resentment, grief, hate, revenge, shame, remorse and a sense of the ludicrous, have also arisen in the nascent mind. We have reached now the mental plane of the higher animals, which is equally that of the human being at about two years of age. Then occurs in the child the mental expansion which separates man from the higher mammals—for something like a year the child mind steadily grows from the status of the latter to the status of the human mind. This year in the individual, during which it walks erect, but possesses a receptual intelligence only, not having yet the power of forming either concepts or true words, represents in the race the age of the alalus homo, the period of perhaps a hundred thousand years, during which our ancestors walked erect, but, not having self consciousness, had no true language. At the average age of three years in the individual self conciousness is born, and the infant, from the point of view of psychology, has become a human being. But we all know that after the attainment of the distinctively human faculty, self consciousness, the child has still much to acquire, both in the way of the expansion of already possessed faculties and in the acquisition of new ones, before it is mentally a mature man. Of the numerous faculties which it still has to acquire I shall mention only here the color sense, the sense of fragrance, the human moral nature and the musical sense. A consideration of these four and of self consciousness will occupy the short time allotted me to-day.

And first a word as to that basic and master human faculty, self consciousness. It occurs, as said, at about the average age of three years, but when it first made its appearance in the race it must have done so at full maturity; perhaps at the age of twenty, both life and childhood being shorter at that time than they are to-day. You will see at once why I say self consciousness must have occurred at first at maturity. Its acquisition at a given epoch supposed a higher mental life than had hitherto existed—such higher life on the part of the race could not have come to the individual before his maturity. To suppose that it would be (if you will think of it) a contradiction in terms. The human mind attains its high water mark at maturity (that is what the word means), and one generation could not reach before maturity what the preceding generation had not reached at all. Well, but self consciousness occurs to-day at three years of age, and we reach full mental maturity (on the average) only at the age of thirty-five. The advance then made by the individual from the age of three to that of thirty-five represents the advance of the race between the date of the appearance of self consciousness and to-day, the mental status of the three-year-old child to-day being the mental status of the adult when self consciousness first appeared. How long has it taken the human mind to grow from mere self consciousness to its present stature? Not less certainly than several hundred thousand years. Whatever the time required, is the time during which man has inhabited the earth.

Of all the mental faculties below self consciousness each one has its own time for appearing in the human infant—as, for instance, memory and simple consciousness appear within a few days after birth, curiosity ten weeks after, use of tools twelve months after, shame, remorse and a sense of the ludicrous—all of them about fifteen months after birth. Now it is to be noted that in every instance the time of the appearance of a faculty in the infant corresponds with the stage at which the same faculty appears (as far as can be at present ascertained) in the ascending animal scale; for instance, memory and simple consciousness occur in animals as primitive as the echinodermata, while the use of tools is not met with below monkeys, and shame, remorse and a sense of the ludicrous are almost, if not entirely, confined (among animals) to the anthropoid ape and the dog.

To turn now to the true subject of this paper, I want to say in the first place that, as in prehuman, so in human psychology, each superadded faculty was acquired in its own time in the history of the race, and that that historic period corresponds with the time in the life of the individual into whom the faculty is born to-day. For instance, self consciousness appears in the individual at the age of about three years—it appeared in the race several hundred thousand years ago. It has been proved by Geiger and others that our color sense has been acquired by the race not more than about thirty thousand years ago. Well, it is acquired by the individual at the age of about five or six. It is thought that the sense of fragrance was acquired by the race later than the color sense; it is also acquired later by the individual. Some considerable study of history has led me to the conclusion that our human moral nature cannot be more than ten thousand years old. For a careful consideration of the records that have come down to us from the early Romans, Hellenes, Hebrews, Egyptians, Assyrians and Babylonians would indicate, I think unmistakably, that, as we go back into the past, this faculty tapers down toward the vanishing point, and that if it continues so to taper as we ascend the ages, all of what we distinctively call our human moral nature would certainly have disappeared by the time we had gone back the number of centuries mentioned—that is, ten thousand years.

Well, to-day the human moral nature in the individual, instead of being born at the age of three years, as is self consciousness, or at five or six, as is the color sense, does not come into existence before the average age of about fifteen years. As to the musical sense, it is almost certainly less than five thousand years old in the race, and, when it occurs at all, is not usually born in the individual before adolescence.

There are three other laws, each well worthy of notice, which govern the acquisition of new faculties by any given race. They are as follows:

1. The longer a race has been in possession of a given faculty, the more universal will that faculty be in the race. This proposition scarcely needs proof—every new faculty must occur, first of all, in one individual, and as other individuals attain to the status of that one they too will acquire it, until after perhaps many thousands of years, the whole race having attained to that status, the faculty shall become universal.

2. The longer a race has been in possession of a given faculty, the more firmly is that faculty fixed in each individual of the race who possesses it. In other words,

* An address delivered at the opening of the section of psychology, at the annual meeting of the British Medical Association at Montreal, September 1, 1897.

the more recent is any given faculty, the more easily is it lost. High authority, such as that of Charles Darwin, could be quoted in support of this proposition; but it scarcely seems to be required; it is almost, if not quite, a self-evident proposition.

3. A study of dreaming seems to reveal the fact that in sleep such mind as we have differs from our waking mind, especially by being more primitive; that, in fact, it would be almost strictly true to say that in dreams we pass backward into a prehuman mental life; that the intellectual faculties which we possess in dreams are, especially, recepts as distinguished from our waking concepts; while in the moral realm they are those faculties such as remorse, shame, surprise, along with the older and more basic sense functions, which belonged to us before we reached the human plane; and that the more modern mental faculties, such as color sense, musical sense, self consciousness, the human moral nature, have no existence in this condition, or if any of them do occur, it is only as a rare exception.

Let us now compare, one with the other, a few of the faculties which have been already mentioned in the light of the rules laid down. To do this will give us, more clearly than perhaps anything else could, a definite notion of the growth of mind by the successive addition of new functions. For this purpose we will take simple consciousness, shame, self consciousness, color sense, the human moral nature, and the musical sense.

Simple Consciousness.—Simple consciousness makes its appearance in the human infant at the age of a few days; it is absolutely universal in the human race; it dates back certainly to the earliest mammals, and probably much earlier; it is lost only in deep sleep and coma; it is present in all dreams.

Shame.—Shame is said to be born in the human infant at the age of fifteen months; it is a prehuman faculty, being found in the dog and in apes, and undoubtedly existed in our prehuman ancestry; it is almost universal in the race, being absent only in the lowest idiots; it is very common in dreams.

Self Consciousness.—Self consciousness makes its appearance in the child at the average age of three years; it is not present in any species but the human; it is, in fact, that faculty the possession of which by an individual constitutes him a man. It is not universal in our race, being absent in all true idiots; that is, it is permanently absent in about one in each thousand human beings born into the world. In our ancestry it dates back to the first true man; a race, we are told, unclothed, walking erect, gregarious, without a true language, to a limited extent tool using, destitute of marriage, government, or of any institution, animal, but, in virtue of its highly developed receptual intelligence, king of animals, which developed self consciousness, and by that fact became man. It is impossible to say how long ago it was when this event occurred, but it could not have been less than several hundred thousand years. This faculty is lost much more easily and frequently than is simple consciousness. We lose it in coma and also often in the delirium of fever; in certain forms of insanity, as in mania, it is often lost for weeks, even months at a time; and lastly, it is never present in dreams.

Color Sense.—I have elsewhere written at large on the color sense, and have only space here to give the facts which bear on the present inquiry. That these are facts the argument referred to, I think, demonstrates. This faculty appears in the individual at the average age of about five years. It is absent in one adult human being out of every forty-seven; it appeared in our ancestors, as Geiger has shown from linguistic paleontology, in the Aryan period, probably less than thirty thousand years ago. It is seldom present in dreams, and when it does occur—that is, when any color is seen in a dream—it is generally that color which, for good reasons, was first perceived by man, namely, red.

The following occurrence illustrates (I think in a striking manner) the usual absence of the color sense during the partial consciousness which occurs in sleep. A man whose hair is white dreamed that he was looking in a glass and saw plainly that his hair was not only much thicker than he knew it to be in fact, but instead of being white, as he also knew it to be, it was black. Now, he well remembered in his dream that his hair had never been black. It had, in fact, been a light brown. He wondered (it is worth mentioning here that wonder or surprise is a prehuman faculty, and is common in dreams) in his dream that his hair should be black, remembering distinctly that it had never been so. (I may say here that memory is a prehuman faculty, and is common in dreams.) The important thing to note about the dream under consideration is that, though it was clear to the dreamer's mind that his hair had never been black, yet he did not remember that it had been brown. For some reason (and I think the reason is quite clear) there was a difficulty in calling up before consciousness any color.

Moral Nature.—The human moral nature belongs to a much later stage of evolution than any of the faculties so far considered. It does not make its appearance in the individual before the average age of fifteen years. It is congenitally and permanently absent in at least forty human beings out of every thousand. It would seem clear, as stated already, from a consideration of our historic ancestors, from the fact that this faculty rapidly fades out as we ascend into the past, that it cannot have existed in the race more than ten thousand years at the most. It is far more unstable in the individual than are older faculties, such as self consciousness. It is never present in dreams.

Musical Sense.—Finally, the musical sense (a faculty which is now in the act of being born into the race) does not appear in the individual before the average age of about twenty years It does not exist in more than half the members of the race. It has existed less (perhaps considerably less) than five thousand years in the race. It is never, or almost never, present in dreams, even in the case of professional musicians.

The Scheme of Mental Evolution.—You see now clearly the scheme upon which I suppose the mind (as far as we have got) to have been built. I say advisedly "as far as we have got," because, if the mind has grown in the way set forth, it is still growing and is not built, but is in the act of building. No man can ever say positively that his theory (of any fact) is the true one, but I am prepared to say of the above hypothesis that, if it be accepted, it will enable us to understand something of the phenomena of mind as we observe it, whereas, if we should prefer to hold, as many do, that the human mind was created independently of any that preceded it by a fiat and per saltum, then I say deliberately that there is and can be no such thing as a science of psychology, and that every attempt to investigate or explain, to comprehend or divine the rationale of the facts observed as to its origin and growth in the individual must remain forever futile. And, if I could find the right words, I would bring home to each one who hears me the inextinguishable conviction that, in this idea of evolution, lie enfolded the mystery of the past, the explanation of the present, and the sure prescience of the future—what we were, what we are, and what we shall be.

The Atavistic Theory of Idiocy and Insanity.—In conclusion, I desire to refer briefly to two corollaries which flow from this hypothesis. The first is that if it is correct, then all forms of insanity, including all forms of idiocy, are nothing more nor less than cases of atavism. In this view, insanity is due to congenital absence or imperfection (leading to breakdown) of some faculty or faculties, such absence or imperfection being due to more or less complete reversion to an ancestral type. In my opinion, this view explains insanity and its numerous forms more completely than these can be explained from any other point of view, and is, therefore, of great value to the thoughtful student of these phenomena. Upon this view the comparatively recent origin and rapid evolution of the human mind, and especially the rapid mental evolution of the so-called Aryan peoples in the last four or five thousand years, is almost solely responsible for the large number of cases of insanity in the modern civilized world, since the stability of any form, function, or faculty in any race is dependent upon the time it has existed in that race, and, therefore, the more recent a faculty is in a race the more frequently will it be found absent, defective or unstable in the individuals of the race.

Future Development of Mind.—The second corollary, which is even more important than the first, is that, upon the view here set forth, the human mind at present is not formed, but forming; is not completed, but in process of construction. By slow and dubious steps taken in darkness our remote ancestors wearily climbed to simple consciousness. After another immense interval they reached self consciousness. But that cannot be the end—the cosmic process cannot stop there—cannot, indeed, stop anywhere. Evolution, as far as we can see, has always gone on, is going on to-day, and will always go on. Our old mental faculties are some of them fading out, others advancing toward greater perfection, and alongside of them new ones are springing up, some of which will, without doubt, be of overshadowing importance in the future.

So-called telepathy and clairvoyance seem to be specimens of such nascent faculties. I place in the same class the phenomena of what is often named spiritualism. The labors of the Society for Psychical Research have made it to me plain that these phenomena, as notably in the case of W. Stainton Moses, really exist. And I think that a study of the above-mentioned case, together with that of Mrs. Piper and that of Mary J. Fancher, of Brooklyn, would compel any unprejudiced person to make the same admission. But to me these are not cases in which outside agents are acting on or through a human being, but are cases in which a given human being has faculties which are not commonly possessed. Whether any given faculty, such as one of those now alluded to, shall grow, become common, and finally universal in the race, or wither and disappear, will depend upon the general laws of natural selection, and upon whether the possession of the nascent faculty is advantageous or not to the individual and to the race.

But of infinitely more importance than telepathy and so-called spiritualism (no matter what explanation we give of these, or what their future is destined to be) is the final fact to be here touched upon. This is that superimposed upon self consciousness, as is that faculty upon simple consciousness, a third and higher form of consciousness is at present making its appearance in our race. This higher form of consciousness when it appears occurs, as it must, at the full maturity of the individual, at about the age of thirty-five, but almost always between the ages of thirty and forty. There have been occasional cases of it for the last two thousand years, and it is becoming more and more common. In fact, in all respects, as far as observed, it obeys the laws to which every nascent faculty is subject. Many more or less perfect examples of this new faculty exist in the world to-day, and it has been my privilege to know personally, and to have had the opportunity of studying, several men and women who have possessed it. In the course of a few more millenniums there should be born from the present human race a higher type of man possessing this higher consciousness. This new race, as it may well be called, would occupy, as toward us, a position such as that occupied by us toward the simple conscious alalus homo. The advent of this higher, better and happier race would amply justify the long agony of its birth through the countless ages of our past. And it is the first article of my belief, some of the grounds of which I have endeavored to lay before you, that a race is in course of evolution.

FURTHER EXPERIMENTS ON THE LIQUEFACTION OF FLUORINE.

By M. MOISSAN and J. DEWAR.

IN May, 1897 (Comptes Rendus, cxxiv, 1202), we had the honor of presenting to the Academy our first experiments on the liquefaction of fluorine; we will now describe some fresh experiments we have made on this subject.

Liquefaction of Fluorine.—Our latest experiments on liquefaction were carried out by means of an apparatus similar to that which we have already described, that is to say, a glass bulb fused to a platinum tube, which contained another similar smaller tube; but each of these tubes was fitted with a screw valve in such a manner that at any moment communication, either with the outer air or with the current of fluorine, could be interrupted. This little apparatus was placed in a cylindrical glass receptacle, with double sides, containing liquid air. The whole was connected with a vacuum pump and furnished with a manometer.

In a series of preliminary experiments we determined exactly the boiling points of liquid oxygen at various pressures, as shown by the manometer.

In some former experiments we had shown that fluorine does not become liquid at the temperature of boiling oxygen at the ordinary atmospheric pressure.

We now find that, by repeating the same experiment with freshly prepared liquid air, the fluorine becomes liquid as soon as the air begins to boil at the ordinary pressure.

We have repeated our former experiment, with liquid oxygen as refrigerant, and, on making a vacuum, we find that the liquefaction of fluorine takes place by the evaporation of the oxygen at a diminution of pressure of 32·5 cm. of mercury.

From these two experiments we are enabled to state that the boiling temperature of fluorine is very close to —187°.

Experiments on Solidification.—When the little glass bulb was three-quarters full of liquid fluorine, we closed both the valves and then caused the liquid air serving as refrigerant to boil rapidly at a diminution of pressure of 72·5 cm. Under these conditions we obtained a temperature of —210°. The fluorine did not show any sign of solidification, but retained its characteristic mobility. To complete this experiment it becomes necessary to cause the rapid ebullition of the liquid fluorine thus obtained; we hope to achieve this in future experiments. When we had repeated this experiment several times, a slight accident occurred to one of our little instruments containing the fluorine. The screw of one of the valves becoming worn, allowed the air to enter the bulb. This air was immediately liquefied, and in a few moments we had two distinct layers of liquid; the upper, colorless layer consisted of liquid air; the lower one, of a pale yellow color, being fluorine.

In another experiment, taking great precautions to prevent the ingress of any air, the fluorine was introduced in its liquid state into a glass tube, the end of which was then sealed before the blowpipe. The sealed tube, containing the liquid fluorine, was kept for a long time at —210° by the rapid evaporation of a large quantity of liquid air, but it gave no trace of a solid body.

Density of Liquid Fluorine.—To determine the density of liquid fluorine, we brought it into contact with a number of bodies whose density is known exactly. By taking groups of bodies whose densities are very close to each other, it is easy to see which sink and which float in the liquid. This well known though indirect method was the most suitable for these delicate experiments. We first of all satisfied ourselves that the fluorine had no action on the materials used. To effect this we placed a crystal of sulphocyanide of ammonium (density = 1·31) in a glass tube surrounded with boiling liquid air; we then turned in to the bottom of the tube a current of fluorine gas by means of a platinum jet. The fluorine was rapidly liquefied, and the sulphocyanide of ammonium was not attacked. We repeated the experiment with a fragment of ebonite (D = 1·15), of caoutchouc (D = 0·99), of wood (D = 0·96), of amber (D = 1·14), and of oxalate of methyl (D = 1·15). It is of importance, in the experiments we have just mentioned, that the various materials used should be first kept at a temperature of —200° for some little time.

In one of our experiments a piece of caoutchouc, having been insufficiently cooled, took fire on the surface of the liquid and burnt completely away with a brilliant flame, without leaving any residue of carbon.*

The experiment was carried out in the following manner: In a glass tube closed at one end, and of which the lower part had been slightly drawn out, we placed fragments of the five substances we have just mentioned. The tube was then plunged to a third of its length into boiling liquid air. When it was all reduced to a temperature of about —200° we carefully introduced the fluorine gas. This soon became liquefied, and we saw the wood, the caoutchouc and the ebonite floating easily on the surface of the pale yellow liquid. On the other hand, the oxalate of methyl remained at the bottom, while the amber rose and fell in the liquid, appearing to be of the same density. The apparatus was shaken several times, and the quantity of liquid fluorine increased, but the results were always the same.

We, therefore, arrive at the conclusion from these experiments that the density of liquid fluorine is 1·14. Another point which appears to be of interest is the following: The fragment of amber floating in the fluorine was very difficult to distinguish, which would seem to indicate that the index of refraction of liquid fluorine is very close to that of solid bodies.

In another experiment we liquefied fluorine in a glass tube which had been previously graduated; we then sealed the tube, which had been weighed before the experiment, and left it alone in a beaker full of liquid air at the ordinary pressure. An hour and a half afterward, the tube still being in 1 cm. of liquid air, the fluorine had not changed in appearance. But shortly afterward, when the air had all evaporated, a violent detonation occurred; the sealed tube and the double beaker in which it had been placed were smashed and reduced to powder. The sealed tube showed us that liquid fluorine sustains at from —187° to —210° a diminution of volume of $\frac{1}{11}$.

Absorption Spectrum.—We examined with the spectroscope different samples of liquid fluorine through a thickness of about 1 cm., either in sealed tubes or by means of our little condensing apparatus, but we have never been able to detect absorption bands.

Magnetism.—Liquid fluorine placed between the poles of a powerful electromagnet does not show any magnetic phenomena. These experiments are the more decisive, as we made comparative ones with liquid oxygen, as before; they were repeated several times.

Capillarity.—The capillary constant of fluorine is weaker than that of liquid oxygen. A capillary tube

* This piece of caoutchouc ran about the surface of the liquid like sodium on water, giving a very intense light.

plunged successively in fluorine, oxygen, alcohol and water gave the following figures:

Height of liquid fluorine	3·5 mm.
" " oxygen	5·0 "
" alcohol	14·0 "
" water	22·0 "

THE ACTION OF SOME SUBSTANCES ON LIQUID FLUORINE.

Hydrogen.—Liquid fluorine in a glass tube was cooled down by liquid air boiling at a low pressure. A slow current of hydrogen gas was made to impinge on the surface of the yellow liquid by means of a platinum jet. There was immediate combination, with the production of a flame which lighted up the tube. The experiment was repeated by dipping the platinum jet below the surface of the liquid. At this temperature (—210°) complete combination still took place, with a considerable evolution of light and heat.

In another experiment the hydrogen apparatus terminated with a fine glass tube dipping into the liquid fluorine; when the hydrogen was turned on, the combination took place immediately and with violence.

Oil of Turpentine.—Oil of turpentine, frozen and cooled down to —210°, is attacked by liquid fluorine. To perform this experiment we placed a little oil of turpentine at the bottom of a glass tube surrounded with boiling liquid air. As soon as a small quantity of fluorine was liquefied on the surface of the carbide the combination took place with explosive force, a brilliant flash of light and deposition of carbon. After each explosion the current of fluorine gas was kept up slowly, a fresh quantity of liquid fluorine was formed and the detonations succeeded each other at intervals of from six to seven minutes. Finally, after a longer interval of about nine minutes, the quantity of fluorine formed was sufficient to cause at the moment of the reaction the complete destruction of the apparatus.*

Oxygen.—The action of liquid oxygen has been studied with much more care, since we observed from our earliest experiments that by passing a current of fluorine through liquid oxygen we obtained a detonating body.

If we bring a current of fluorine on to the surface of liquid oxygen in a glass tube, the fluorine dissolves in all proportions, imparting a yellowish color, and giving the liquid a graded tint from the upper to the lower part; the bottom of the tube is hardly colored. If, on the contrary, we introduce the fluorine gas at the bottom of the liquid oxygen, the yellow color is produced at the bottom and diffuses slowly to the upper layers.

This phenomenon indicates that the densities of liquid fluorine and oxygen are very near each other. When we have obtained a mixture of liquid oxygen and fluorine, if we allow the temperature to rise slowly, the oxygen evaporates first. The liquid becomes more and more concentrated as to fluorine, and finally the latter begins to boil in its turn. In fact, at the commencement of this boiling the gas coming off will light a match which has only a red hot point, and will not make lampblack or silicon red hot; but, on the other hand, the gas coming off at the end of the experiment will instantly cause these two latter bodies to burst into flame. When the glass bulb is completely empty and its temperature is rising, we suddenly notice a distinct disengagement of heat, and the interior of the glass loses its polish. This rise of temperature is due to the fluorine gas attacking the glass. In this experiment, when using perfectly dry oxygen, no precipitate is produced. If, on the contrary, we use oxygen which has been some hours in contact with the air, the detonating substance we mentioned in our previous communication is produced with great readiness.

In one of our experiments, in which we tried to obtain a notable quantity of this body, we had an explosion strong enough to smash the glass in which the experiment was being performed.

To sum up, this body, which is produced by the action of fluorine on moist oxygen, seems to be hydrate of fluorine, decomposing, with detonation, by a simple rise of temperature.

Water.—We froze and cooled down to —210° a small quantity of water at the bottom of a glass tube. Liquid fluorine formed on the surface of the ice as a mobile liquid without action, and it evaporated on the temperature rising. As soon as the apparatus became warmer the remaining gaseous fluorine attacked the ice with great energy, and we noticed a strong smell of ozone.

Mercury.—We solidified a globule of mercury at the bottom of a tube. The surface remaining very brilliant, the liquid fluorine surrounded it without causing it to lose its appearance or polish. On allowing the temperature to rise to —187°, the fluorine began to boil, the liquid disappeared completely, but the attack of the mercury by the fluorine gas did not take place until the apparatus had almost reached the temperature of the laboratory.

CONCLUSIONS.

Fluorine gas is easily liquefied at the temperature of boiling atmospheric air. The boiling point of liquid fluorine is —187°. It is soluble in all proportions in liquid oxygen and in liquid air. It does not solidify at —210°. Its density is 1·14, its capillarity is less than that of liquid oxygen; it has no absorption spectrum and it is not magnetic.

Finally, at —210° it has no action on dry oxygen, water or mercury, but it reacts, with incandescence, on hydrogen and oil of turpentine.—Comptes Rendus, cxxv, No. 15, p. 505, 1897.

In his monthly report to the Chief of Engineers, Col. T. W. Bingham, Commissioner of Public Buildings and Grounds, says that 10,401 persons went to the top of the Washington Monument during October, and 3,337 of them walked. Since October 9, 1888, when the monument was opened to the public, 1,453,555 persons have gone to the top.

Olive growing on the Italian Riviera is giving way to the cultivation of flowers, chiefly roses and pinks, for the London and Paris markets.

* In several of our experiments we accidentally let a little liquid fluorine fall on the floor; the wood instantly took fire.

ROLLER BOATS.

THE Bazin roller boat is slowly proceeding with experiments that up to the present have not completely responded to the hopes of its inventors. It is very certain that in the preparatory studies certain factors were neglected that intervened in large proportions to diminish the speed that it was expected to obtain. Thus, in an experiment made upon the Seine, in an unobstructed course, the speed did not exceed eight or nine knots with the propelling and rotary engines developing their full power. According to calculations, from eighteen to twenty knots ought to have been obtained. The two resistant forces that have the most action are adhesion and the friction of the water against the rollers.

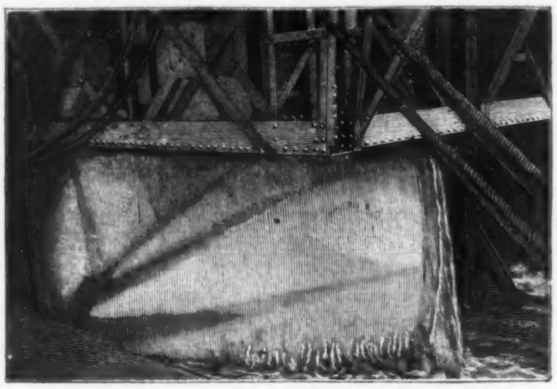


FIG. 1.—STERN LARBOARD ROLLER.

Fig. 1 represents one of the rollers supposed to be moving at a velocity of from ten to twelve revolutions at the fixed point. The water is carried along to the upper part, not only upon the external circumference, but also upon a large part of the spherical cap. There is thus produced a great resistance which it will never be possible to get rid of, even as has been proposed, by covering the wheels with a coat of varnish or with a fatty substance.

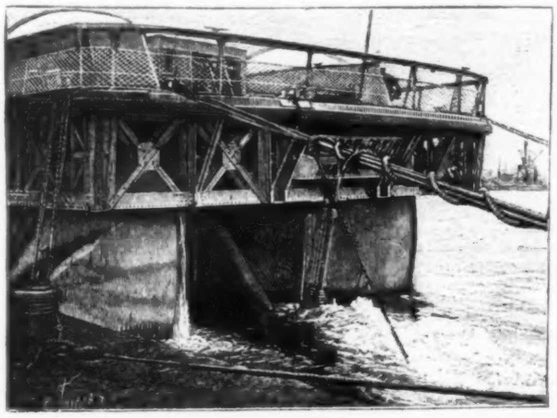


FIG. 2.—VIEW OF THE STERN OF THE BAZIN ROLLER BOAT.

The second cause of resistance is due to the friction of the water against the four rollers, the submerged surface of which is quite wide. It has often been said that in the Bazin roller boat rolling friction is substituted for sliding. This is true only in part, since, in consequence of the speed of the boat and of the revolution of the rollers, there is developed upon the submerged portion of the latter a force of sliding friction that there is reason for taking into account in the appreciation of the results.

There is another drawback that this type of vessel will always present, and in regard to this all mariners are unanimous, and that is the difficulty, not to say impossibility, that will be found of remaining at sea in foul weather.

One must never have seen the water of the ocean during a squall of wind, and consequently be ignorant of the power and violence of the waves, to believe that such a vessel is capable of resisting them. It would, as sailors say, be swallowed by the sea, even were it capable of supporting the stresses that huge waves, breaking under the foot bridges, would exert upon the latter and cause the whole thing to capsize.

Fig. 2, which represents the stern of the roller boat, plainly shows to what dangers the four faces of such a vessel are exposed.

It may be added that, were the Bazin roller boat to make the high speeds predicted by its inventors, it might be utilized upon lakes and large rivers for the carriage of passengers, since there is not enough space upon it to permit of doing a large freight business.

The idea of constructing a boat to roll upon the sea is not new. The Call, a San Francisco newspaper, in its issue of November 20, 1895, devoted an article entitled "To Roll upon the Water" to the description of a vessel that was to rival the fastest trains in speed (Fig. 5). Mr. Chapman describes his invention as follows:

Between two huge cylinders are suspended the hull, the deck and the cabins for freight and passengers. Along each side are the foot bridges that connect the axes of the two cylinders. Upon these axes, which are fixed, revolve, in ball bearings, the bases of the two cylinders and, consequently, the cylinders themselves.

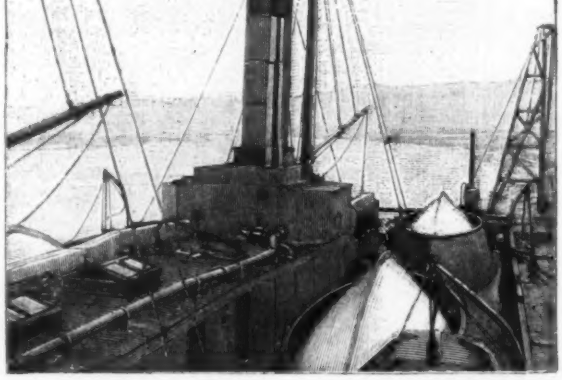


FIG. 3.—STERN LARBOARD AS SEEN FROM THE FOOTBRIDGE.

In order to obtain the motive power necessary for the motion, there is placed upon the internal surface of the cylinders an iron track upon which runs a locomotive moved by electricity. As soon as this locomotive begins to run, the large cylinders will begin to revolve. The inventor has found by experiment that a very large wheel revolves with greater ease when the motive power is applied as described above. The height of the engine has considerable influence in proportion to its weight, and a very high speed ought thus to be obtained. What will the latter be? Mr.

Chapman cannot say, but he sees no reason why it should be less than that of the modern railways.

The trip from the United States to England might be made in three days or even in forty-eight hours. There would thus be greater chances of passengers making such a trip without seasickness. Here and there, upon the generatrices of the cylinders, there are projections that will cause the latter to move forward instead of simply revolving. Besides, in the center of the height of each cylinder, and at right angles with the generatrices, there is arranged a projection that is higher than the preceding and that will subserve the same purpose as the keels of the present ships. Rudders may be placed at the stern on each side and be connected with the fixed axes.

With cylinders of a hundred feet or more and a space of from four to five hundred feet between the two,

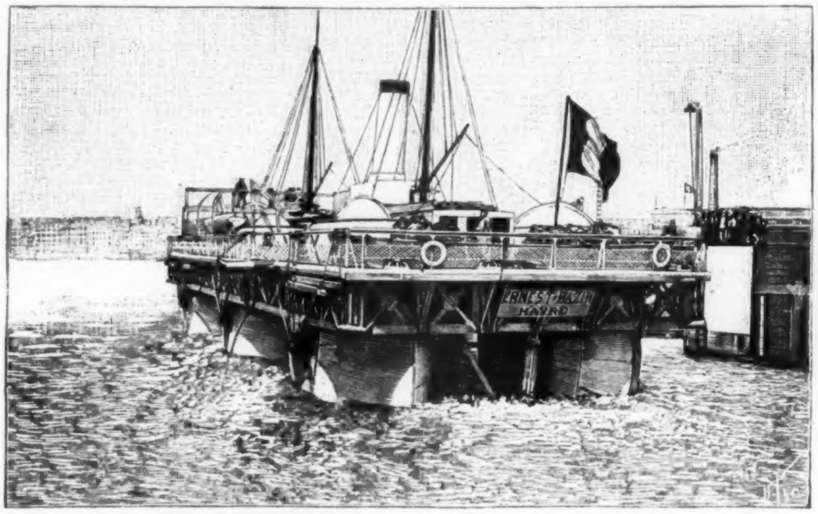


FIG. 4.—GENERAL VIEW OF THE BAZIN ROLLER BOAT.

rolling and, consequently, seasickness will be almost entirely prevented.

It is well to remark that the locomotive will always keep the same position with respect to the axes, that is to say, at the bottom of the cylinder, whatever be the speed. In this way, it is possible to enter the interior of the hollow axes through the lateral foot bridges, and from there to ascend by a ladder to the engine.

The most interesting part of the invention consists in the reduction of the net cost. It is possible, in fact, to save nine-tenths and even nineteen-twentieths over the price of an ordinary vessel. Instead of huge boilers and engines that necessitate an army of stokers, there will be need of but two locomotives. In cases in which a great speed would not be obtained, the diminution in the net cost would again render the invention useful, particularly if it were a question of operating upon rivers or canals, where freight charges should be low. It is the great problem of the future to be able to increase the speed of ships upon canals without injuring the banks. Screws and paddle wheels are not practical, on account of the violent motion of the water that they produce. With this new vessel, the cylinders will simply roll over the water without the least agitation of the latter, even at the highest speed of the largest ocean steamers.

As may be seen from this brief description, Chap-

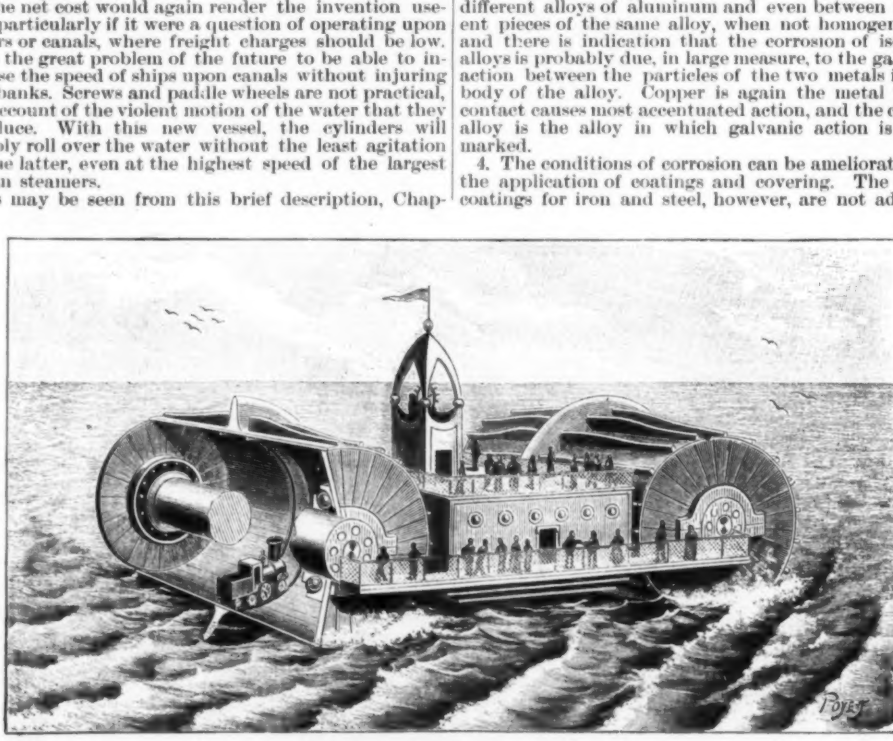


FIG. 5.—THE CHAPMAN ROLLER BOAT.

man's roller boat must have the same qualities as Bazin's. It is probable that the results anticipated by the inventor have not been obtained, for, since 1895, this new boat, which was to revolutionize the art of naval construction, has not been heard of. We hope that the Bazin roller boat will have more success than its predecessor.—La Nature.

On October 19 the Illinois Steel Company turned out 1,248 tons of rails and billets on the day shift of 12 hours and 1,160 on the night shift, or 2,408 tons in 24 hours. They expected to turn out 47,000 tons in October, beating the world's record.

NOTES ON THE YACHT DEFENDER AND THE USE OF ALUMINUM IN MARINE CONSTRUCTION.

By RICHMOND PEARSON HOBSON, Assistant Naval Constructor, U.S.N.

IN a paper contributed to the United States Naval Institute, Annapolis, Md., Mr. Hobson presents an exhaustive scientific report on the construction of the Defender and other aluminum craft, the corrosion of aluminum from salt water, and the present and future uses of aluminum in marine construction. The complete text of the paper is published in a recent number of the Institute. In reviewing the subject of corrosion Mr. Hobson writes as follows:

The experience in actual service and the experiments made are inadequate to a definite and final conclusion as to the corrosion of aluminum in salt air and salt water.

The consensus, however, would lead to the following general conclusions:

1. When isolated, pure aluminum is not attacked.

2. When isolated, the usual alloys of aluminum and commercial aluminum are attacked in a measure more or less proportional to the amount or per cent. of the alloy or impurities. Among the alloys, copper and zinc seem the most corrodible.

3. When in contact or communication with other metals below it in electrochemical scale, galvanic action sets in and aluminum and its alloys are rapidly corroded. The action takes place when the contact is between different alloys of aluminum and even between different pieces of the same alloy, when not homogeneous; and there is indication that the corrosion of isolated alloys is probably due, in large measure, to the galvanic action between the particles of the two metals in the body of the alloy. Copper is again the metal whose contact causes most accentuated action, and the copper alloy is the alloy in which galvanic action is most marked.

4. The conditions of corrosion can be ameliorated by the application of coatings and covering. The usual coatings for iron and steel, however, are not adapted to aluminum, particularly red lead. In case of special coatings, as yet prepared, special care and frequency of application are required. It would seem that the special characteristic to be sought is impermeability.

While drawing the above conclusions on corrosion, the imperfect behavior of steel and iron should be borne in mind. With full appreciation of this imperfection, however, the comparison of the two metals gives the following general results:

1. At the present stage, structural aluminum is materially more subject to corrosion than steel. The marked corrosion, however, must be attributed to galvanic action due to the high electropositive character of aluminum, the pure metal itself, practically incorrodible, being far ahead of steel, and to this galvanic action must be attributed the corrosion of alloys and the usual commercial aluminum where even there is no external contact with other metals, the action taking place in the body of the metal from the intimate contact of the molecules of aluminum with the molecules of the alloying metals or impurities.

2. This feature of inferiority must therefore be regarded as subject to future amelioration from increase of knowledge and selection in the preparation of the alloys and from improvement in conditions of insulation and protection. Substantial amelioration has already been found in the use of nickel for the alloy, without entailing loss of strength, while further amelioration seems promised in the use of tungsten for the alloy.

Special measures toward insulation seem not to have been taken or tested in any case.

3. The coatings used for painting steel are not effective in protecting aluminum, and the special coatings as yet prepared are but partially effective, and then only on condition of special care and frequent renewal.

4. This feature of inferiority must likewise be regarded as subject to future amelioration with further experiment and increase of knowledge. It could scarcely be expected to find a suitable coating without research, particularly when the usual coatings for steel are composed so largely of oxides of metals whose contact with aluminum sets up galvanic action.

5. The degree of importance of the inferiority of aluminum to steel in the question of corrosion varies with the conditions of exposure, and is disqualifying when the exposure to salt water and spray is constant and where frequent visitation is difficult or impracticable.

The cost of maintenance and care and the length of life identify themselves, as seen above, with the question of corrosion. Without being able, evidently, to assign definite values, the cost of maintenance and care at the present moment must be taken as appreciably greater for aluminum than for steel. The cost of additional care is not of great consequence for parts easily accessible, provided the exposure is not great and the coatings applied or the other process of care are at all effective. For parts constantly exposed, multiply the frequency of visitation; the additional cost is considerable, particularly where the parts are difficult of access. In such cases of exposure and difficulty of visitation, the inferior conditions of preservation reduce the length of life, which, under good conditions even, must be considered as shorter than the life of steel. This factor of cost takes on large proportions and, at the present moment, must be considered prohibitory for waterwashed surfaces and parts in contact with bilge water, while still of large consequence for all outside parts, topsides, upper works and upper deck fittings.

The results of the comparisons for strength and weight and for cost lead to the conclusion that at present aluminum is adapted for use in hull work for bulkheads, casings and trunks, small trunks and ducts, hammock berthing and metal ceiling, and for use in hull fittings for parts of ventilation system, for metal doors, hatches, torpedo ports and coaling ports, metal ladders and gratings, masts and spars, this adoption in the case of a 9,000 ton vessel realizing a saving in weight of about 380 tons, at an increase of about $250,000.

The same results lead to the conclusion that as soon as an efficient coating is found, aluminum will be further adapted for the bottom plating of sheathed vessels, for the bottom and topside plating of small vessels, part of the topside plating of large vessels, for bottom and topside framing of small vessels, for topside framing of large vessels, for the bottom framing of large vessels, except outer angles in double bottom, for inner bottom plating, and deck plating, and for dead light, airport and deck light frames and casings, realizing by this adoption in a 9,000 ton vessel a saving in weight of about 380 tons, at an increase of cost of about $260,000.

It is to be remarked that in the above applications it is assumed that galvanic action does not set in from the contact of aluminum and steel, an assumption apparently justified by experience thus far; but, in course of time, it is largely probable that appreciable action would set in, if some insulating provision were not made in the joints between the two metals. It is not believed, however, that such insulation provision would be impracticable.

It may be recalled, also, as stated in the outset, that performances and homogeneity of aluminum as taken are somewhat ahead of the present stage of manufacture, and that the applications have been extended to dimensions and scantlings not yet commercially turned out.

Moreover, it should not be overlooked that the element of cost in the maintenance and care of aluminum construction and the length of life are not well determined and are difficult to valuate on account of the limited experience.

The results arrived at are thus to be taken in connection with the limitations necessarily imposed by the fact of the field being essentially new.

In summation and in conclusion, aluminum has incontestable virtues as a structural material. Its great elastic elongation and resistance within the elastic limit places it far ahead of steel for resisting usual, well determined and repeated dynamic forces, while its great comparative lightness marks it for marine construction. On the other hand, it has serious defects. An excessively low elongation beyond the elastic limit unfits it entirely for use where liable to be subjected to violence and unknown dynamic forces; temperatures beyond atmospheric undermine its physical properties; while notwithstanding an innate superior resistance when pure to the attack of corroding agents, the high position on the electrochemical scale, causing excessive tendency to galvanic action, places a severe obstacle in the way of adoption where exposed to salt water and spray, particularly in the case of alloys, in which form alone the metal exhibits its best properties. This last serious defect, however, must be considered as subject to constant amelioration with increase of knowledge and experiment in precautions and higher perfection in manufacture.

Thus, while this new metal has an important field in marine construction, an important field now ready for occupation and additional fields awaiting only the improvement in conditions for resisting galvanic action, these fields are essentially limited, and the larger domains are shut out by impassable barriers.

The early optimist who inferred all virtues from a

single virtue, and the latter reactionist who pronounced general unfitness from a few partial trials, were both wide of the mark. The metal is not Utopian, but it has nevertheless beyond question an important mission for the serious marine architect, who is only waiting further improvement in manufacture and reduction in cost and further amelioration in conditions of corrosion.

For the naval architect of our own country, for our country itself, the question has a special significance.

The maintenance of a strong commissioned naval force must be our country's policy for taking its destined part of international greatness in regulating the common affairs of the planet, but our position and the spirit of the nation marks our naval policy specially for a great force kept economically in reserve commissioned only periodically for drill purposes.

In a state of reserve the conditions of corrosion are greatly ameliorated. The vessels seek and lie in fresh water; the torpedo boats and small boats, which do not seek fresh water, are hauled up under sheds. Under these conditions the great obstacle of corrosion is largely removed from aluminum's path. Indeed, aluminum appears to be superior to steel in resistance to the corroding effects of atmospheric exposure and of fresh water.

The question becomes more significant where account is taken of the great natural facilities and possibilities of our coast line for fresh water basins of large expanse for taking vessels of all sizes. It takes on a still more significant aspect when it is recognized that nature in the inland routes along the coast has marked small craft as our great second line of defense, while in the inland waters of great rivers and great lakes in communication with the sea she has provided immeasurable possibilities for the construction and maintenance of these craft.

Torpedo boats, which are thus marked for a great natural economical branch of national defense, form now the least developed arm of our navy.

There therefore lies ahead, inevitably, a vast programme of torpedo boat construction, for which every advantage of materials of construction should be earnestly sought. Fortunately for the nation, this branch of defense admits of rapid growth and may be expected to have large expansion in the near future. Indeed, the time is not very far distant when, with treaty restrictions abrogated, we shall see on the great lakes vast flotillas of torpedo boats, lying for most of the year in economical reserve free from corrosion. Periodically they will be commissioned for drill purposes and from time to time will sally forth to the seaboard for mobilization and exercise in the operations of coast defense.

We would realize thus, at a minimum cost and a minimum turning away of the nation's energies from the channels of production, a great power, tranquil in time of peace and good will, irresistible for defense in time of war.—Aluminum World.

THE CONDITION OF THE LABORING CLASSES IN MEXICO.

UNDER the joint auspices of the Franklin Institute and the Young Men's Christian Association, Mr. Theodore C. Knauff recently delivered, at Association Hall, Philadelphia, an illustrated lecture under the above title, from which the following excerpts are taken.

A year ago a newspaper paragraph said, "Why is it that the Mexican peon with his sixty cents a day is making more than the American farmer with all his knowledge and invested capital?" The untruthfulness of this parallel is proved by a trip to Mexico to study the peon's life, followed by a trip through Iowa, Wisconsin, etc., to see how the American farmer lives, personally, what percentage are mortgaged, what have paid off their mortgages, what have a bank account and what percentage have money loaned out at interest. In the last presidential campaign Mexico was held up as a great country for the manufacturer and far beyond our own in prosperity; that thither the workingman must go to find the only prosperity then obtainable.

Mexico is not such an insignificant country compared with ours, either in size or wealth; and it was a land of comparatively advanced civilization long before Columbus discovered America, having a representative government and a fairly complete system of laws. With the European advent into and conquest of Mexico she received and absorbed all that was then known of eastern civilization, at a time when all but a very small proportion of this country was inhabited by savages. After a year's exhaustive study of the subject, Mexico now has a certain amount of prosperity; but she went to sleep for several centuries through religious intolerance and did nothing; suffering also from instability and mismanagement in government and from internecine wars. A long series of years overcame all this; she lived again, though behind in the race; and in her effort to catch up developed great opportunities for capital. To that extent it was a newer country than our own, with more chances. About 1860, suffering through a long disaster, from an unmanageable foreign debt, she tried to lift it by virtual repudiation; the man owning a dollar in Mexico knew not how long it would be his; or, having a dollar loaned, how soon he could get it back. Mexico is a silver country, not only by this monetary basis, but as a producer of silver, all its interests, all its industries, are wrapped up in this product, constituting 60 per cent. of her exports today.

At a most critical time President Diaz was confronted with an enormous decline in the value of this national commodity, which must be measured by the foreign product; he faced a great foreign debt contracted in gold, principal and interest—having naught but silver wherewith to pay. $100,000,000 was the gold debt, besides additional debt contracted in silver. That gold debt, comparing the number of their people with ours, is as large as all our national debt; and much larger, comparing the quality of their people with ours. Mexico wanted to borrow money. Should she pay this debt in depreciated silver and thus virtually ruin her reputation? It meant stagnation and ruin. If she simply went to work and paid her debt (just double in face value what she had contracted to pay), that meant stability. Diaz undertook the great task of getting just double this amount of money, which in his country took just twice as long to get—very expensive process, but it paid in the end. To-day, when Mexico wants more money (which she always does), she can get it. The foreigner will loan it, because he knows it will be paid back. Mexico has many multimillionaires who live there and will loan their money to the country; there must be activity and what we call prosperity under such circumstances. Here is the admitted prosperity of Mexico; who benefits by it? Has she been a haven for the unemployed? No. Labor is governed, among other things, by the law of supply and demand. So is capital. Here is a country needing capital, and it is in short supply. On the other hand, here was a country having an unlimited amount of labor, very low priced and largely unemployed, ignorant, and so indolent it was incapable through improved conditions to help itself along; consequently, there was no rise in the price of labor. The wealthy man came along and enriched himself under the advantage of low-priced labor, was invited to go there and virtually wring his profits out of the workingman. It was not a place for the workingman, but for wealthy men to make money out of the workingman. Their low-priced labor is the greatest inducement they put forward for foreign capital. The American silver mine operator is attracted there because the Mexican smelter or miner works for half what the American does and is contented. He lives, apparently happy, on food in quantity not enough for an American child and in quality not the proper thing for an American hog. This cheap labor has been the very source of this cheap money; and this workingman has borne the brunt of what has taken all the efforts of the country to lift in the way of debt. There is no country in the world that is better for monopolies and trusts than Mexico. What has she paid for her prosperity? She is borrowing money all the time to meet the great deficiencies; no means of raising revenue are neglected, and they are all borne by the workingman. If the workingman wants a little delicacy, or a little amusement, he must pay for it in the way of taxes. It is only lately that a middle class has begun to spring up. The wealthy American individual or corporation, going there, puts out money under great concessions—getting advantages virtually wiping out taxation. So, too, the great Mexican land owners form so strong a combination as to virtually rule the country and practically exempt themselves from taxation. The rest comes out of the poor man or the middle class man.

This new Mexico, which is the result of foreign and domestic capital being spent, is apt to be neglected. Because there is so much of the workingman that is picturesque, we neglect the rich man. We went to see how this workingman lives; how he is housed and clothed.

A map of Mexico, projected upon a United States map of the same scale, extends from Maine to Texas. Mexico is sixteen times the size of New York State; Sonora equals Indiana and Ohio combined; Chihuahua, Pennsylvania and New York combined. Mexico's mountain system is a continuation of the Andes widening out into two ranges, leaving in the middle a high, flat tableland, 4,000 to 8,000 feet high, with a volcanic range through it reaching 18,000 feet. The citizens of the capital, Mexico, at 8,000 feet, are 2,000 feet higher than Mount Washington all the time. We feel that altitude, the dryness and rarefaction of the air; and we do a great many things, from atmospheric and surrounding conditions, that we would not do in our own country. Altitudes affect climates more than latitudes. Entering Mexico from El Paso, Texas, we cross over from Torreon on the International Railway to Monterey and Tampico (the latter a seaport); then climb the mountains again to San Luis Potosi on the tableland. At Guadalajara is the great gate made shortly after Cortez entered the country; thence down into the city of Mexico and along the trail of Cortez through some of the grandest scenery in the world, to the seaport Vera Cruz.

Egypt is the only country equaling Mexico in fullness of interest for travelers; and no other frontier in the world presents changes so sudden and so marked as that at El Paso. Everything on the American side looks prosperity; the express wagons, the Pullman coaches, the ordinary American citizen, freight houses, oil shops and factories. Crossing by almost a dry ditch (the water being used for irrigation purposes) to the opposite Mexican town, we pass, in a few seconds, to conditions changed as by a magician's wand. For coats, we have blankets; for hats, sombreros; for prosperity, poverty, by appearance; for a self-respecting population, loafers and beggars; the greatest possible interest in our arrival, the town turning out as to the one event in their lives, conveying the impression that no occupation whatever could be found in the place.

Mexico's population is 12,570,000, two-thirds of whom never slept in a bed, wore stockings, rode or had an ancestor that knew how to ride; and they live to-day at a less expense per man than it costs us to keep the meanest farm horse. Fifteen years ago travelers could not go around unattended. One of the first persons we meet on entering any of the towns in Mexico is the brigand. The Mexican government, when necessity demanded, took two ways of ridding itself of them: one, by sending out troops, putting him against a wall and shooting him; but the leaders were turned into soldiers and put there to catch brigands—a very successful proceeding. The flower of the Mexican army to-day is the Rurale, or rural fellows, the most expert soldiers and riders; at every railroad station are two of them detailed to guard the train and preserve order. The rails of the track bear the best known English stamp or come from Krupp's, in Germany. Iron is very scarce and dear in Mexico, simply for want of capital to get it out. Near the station of Durango is a mountain of nearly solid iron, assaying 90 per cent. metallic iron—enough to supply the world 300 years; but within a very few years iron was sold there for 35 cents per pound.

By whatever route you enter Mexico you must necessarily pass over a desert. In the northern part it only rains during the summer months, and then not even every year. So on all trains the locomotive carries an extra tank car. The question of transportation and the scarcity of water are two pressing problems in that country to-day. Wood costs $12 to $18 wholesale; and what there is has to be cut for railway ties, except when they use iron ties. Coal is also scarce, although there is plenty along the railroads, but it has not yet been mined. The Vera Cruz Railroad imports its coal from England at $20 per ton; while the roads in the north get theirs from Colorado.

On the Mexican tableland the houses are almost universally built of adobe, simply a large block of mud pressed into shape in a mould, then hardened and baked in the sun and laid in flat layers, one on top of the other, in walls 20 inches thick. It makes quite a substantial building, requiring a long time, even in the rainy season, for the water to soak through the walls. A church and a plaza are required before a settlement can be a city. The Mexican farm laborers and their conditions are far inferior to those of the late slaves of our Southern States. The huts have but one opening; no window; no drainage; dirt floors; and the occupants, regardless of sex, wishing to go to bed, simply unroll their mats and, without removing clothing, go to sleep. There are no seats, no utensils other than the pots for cooking and mill for grinding corn. The farm laborer has a certain wage and is given time and place to build himself this house; if he does not build it, he has no house. All these houses are built by the people who live in them. They vary, in some places being mud roofed, in others roofed by palms, or banana leaves or some fiber that will shed moisture when necessary. In the city, they look to the eye as if not built of this mud material, but are exactly similar, except the exterior is plaster coated, resembling our pebbledash. Outside is no particular mark of beauty; but within, the pateo, or hollow square, is bespangled with flowers and very homelike in its surroundings.

The city streets present all one-story houses; dirt floored or tile floored. If any one is so extravagant as to own a carpet, that is put down directly in the doorway. Ventilation is unprovided for, and were it not for the exceedingly dry air, due to the elevation and absence of moisture, the mortality would be frightful. City houses of a better class are made of stone. In constructing an arched extrance they build a form the size and shape of the arch and then build upon it, and when the keystone is in place they take the form away. Many of the houses are unfinished, not because they have not had time, but they do not want to do the work. Also, in some towns, all finished houses are subject to tax; therefore, a great many houses are unfinished. This is the condition, also, of a certain railroad in Yucatan which is being built under government subvention, which subvention they were to receive only until the road was finished. That road, for some twenty years, has been within one mile of being finished.

To see a man working a modern sewing machine in the street is not unusual. All branches of trade are carried on outside in that way. Should you want your shoes repaired, you will find a cobbler on the sidewalk or at the curb, wherever it is convenient for him to be. A policeman on duty in a certain municipality I noticed attending to a piece of knitting; in another, one of the regular government sentries, near a government station, on sentry duty, with bayoneted gun leaning against a wall, while he engaged in what the ladies call their "drawn work"—embroidery.

The wealthy families in the three and four story houses live upon the upper floors and don't care who occupies the others. A person of means has invited you to dinner; you find, after considerable trouble, the stairway and eventually a very small bell pull with his official title underneath. You ring and are at once ushered into the greatest magnificence—all kinds of comforts; and there you find genuine Mexican hospitality, the usual speech (in Spanish) being "The house is yours."

There are shops, but business is conducted largely by peddlers and sidewalk merchants. You find not the shop owner's name over the doorway, but instead an official title, which is the name of the shop. Mexican bread is raised with pulque (the equivalent of yeast) and is always sour, and the bake shop where we tried to get something approaching Mexican bread that we could eat bore the name over the door "La Favorita." A druggist's name, being translated, was "Gate of Heaven." Another was a saloon and bore the name "Port of New York." In still another town (probably a prohibition town) the saloon was called "The Triumphs of the Devil."

In the neighborhood of Zacatecas we found the people gathered about noon around the central fountain. This is a town in which the water is very scarce indeed, the central fountain being the town's sole supply, and the fountain deficient at that. The people have to come very early to get a supply for the day. The supply that comes in the night runs out very quickly, and they have to take the water up in little scoops until the vessel is full. I have been asked, If this be true, what do they drink? There is plenty of water to drink, but not enough for ordinary purposes from our standpoint.

The women wear a kind of cotton shawl over the head or shoulders called a robosa, and the men a woolen garment called a sarappe. Transportation is forced upon our attention, because at every turn on the railroads we see the primitive oxen carts of Cortez' day beside our modern train—an ox cart whose wheel is of three solid pieces of wood. The people who run those wagons—the teamsters—get for their pay fifty cents Mexican per day. The teams themselves are owned by the wealthy proprietors. The oxen are hitched, not by a yoke, but by being tied to the horns—the strongest part of the animal.

The railway traverses a region of great border farms; on both sides, at one place, for eighty miles, is all one large landed estate, belonging to one individual. In another place one estate has 1,500,000 acres; in another, 250,000 acres. Out of a total population of 12,570,000, 6,000 people own all the land, with influence enough to avoid, practically, all taxation, which falls on the poor; and so there is no middle class. At present there is little danger of an uprising of the people, because they are generally content; and if they had a leader there to create an uprising, no one would follow him. The giant cactus grows there—a variety of what we call the prickly pear—bearing a fruit; the leaves are fed to cattle after burning off the thorns; and it is the national plant of Mexico, seen on the Mexican dollar. A species of this plant was used to feed the cochineal insect until the use of aniline colors threw cochineal out of the market; in fact, all the vegetation of the country seems to wear a thorn.

The sarappe, the ordinary garment of the Mexican, is quite thick and of wool; and you might think the people were suffering from the cold. One garment is his coat—sometimes his hat; it is his bed, and numerous other things. It is made usually with a slit or hole in the middle; and when a man is liable to do anything else and wants the use of his arms, he pokes his head through the hole, and when he does not want to do that way, the hole is simply sewed up and he wraps the garment around him.

The feet are usually bare or clothed in a domestic sandal. We sometimes see a white cotton garment, more suitable for the hot countries; but strange to say, we find more of that kind in the tableland, where it is cold, and the sarappe in the lower land, where it is hotter. They simply reverse things. When Cortez entered the country he found the natives all clothed in cotton; it is the native plant; and the armor of the soldiers of the Aztecs who fought Cortez was made of quilted cotton, made to turn back the arrows used between those Indian tribes, but affording no protection at all against the firearms of the Spaniards. In some cases, when our pegged shoes have been sold in Mexico, it has been found that the air is so dry that the pegs drop out and the soles come off, when the soles are used as sandals.

There are to-day in Mexico pure breed Indians—Aztecs of exactly the kind that fought against Cortez; of pure blood, speaking the Aztec language; some of them may be found in the streets of Mexico, and they are of a peculiar bright red—very clannish; they could not have preserved their integrity if they had not been. There are twenty-five original languages of the Indians spoken in the country to-day. All grades of peons are more of the Indian type; but they range all the way from that common class of mixed blood up to nearly pure, true Spanish blood.

The better class, instead of the cotton robosa, wear a shawl, usually black; and the members of this class will not mix with the lower class. The girls in this class work sometimes in factories managed by Northerners at drawn work; some doing it at home, others in the shops, at so much per day. The former go to the factory; get their bundle (a foot long by three inches in diameter) to take home; but so proud are they that they hire a peon to carry it home for a cent or two.

Oil is a great necessity both for light and fuel; but they cannot buy it for any reasonable figure; there is the duty in the first place to pay (a difference in the standard money of more than double), then the risk that has to be taken on it; so that it takes three times the value of the produce to buy it in Mexico, and they must have these outside products. Could a man live on the products of Mexico, he would live very cheaply; but he must have outside products for comfort. Until very lately the products of Mexico were the same, silver bought as much as it ever did; but this last sharp decline in silver has broken the camel's back, and now silver does not buy as much as it ever did and the cost of living has increased, without an increase in the wages, and the excuse the ordinary salesman will make for charging a higher price in Mexico is, as he says, the change in the price of silver.

The burro is the great institution of the country. He will carry more than his own weight and carry it till he drops. The transportation question is being settled now by the railroads being built under a government subvention of from $6,500 to $9,500 per kilometer, about one-fourth of the cost of the railroad, and that is paid in revenue bonds, and six per cent. of the customs duties must be set aside to redeem these bonds. The engineer has charge of the train, while the conductor is a Mexican. But the engine driver runs when he is ready, and not before. Coffee in sacks costs 3 cents per pound additional for transportation 40 miles off the line of the railway and is worth nothing at the distance of 120 miles. The culture of the grape and the silkworm culture was introduced by a reformer in 1810; but the Spanish government wanted to keep the revenue of the colony and so it destroyed all the vines, silk and mulberry trees; and that was part of the many difficulties which led to the rebellion which finally expelled the Spaniards from the country. There are a good many forms of sisal fiber, all coming from a species of maguey. Agave Americana is one particular form from which sisal is made. The Mexican hammocks, coming from Yucatan, are made from sisal. There is another form called henequin; another fiber from the banana leaf, all kinds of articles are made from it; rope, brushes, shoes, bags, fans, carpets, saddles, hats, everything, fibers for ladies' corsets in this country. The straw is thrashed by trampling out by the feet of oxen. Our modern thrashing machine has been introduced; but it is not popular, it makes too much work; it leaves the straw whole. The Mexican wants the straw all broken up by the same thing that gets the grain out, so that it is ready to feed to the cattle. Labor is cheaper than lumber in the country; and that is particularly shown in the way they weigh commodities. Instead of putting up a wooden spar to hold a cross beam, from which the scales may be suspended, they will walk two men around all day with one beam on their shoulders. Whenever an article is to be weighed, these men take the beam and put it across their shoulders and thus become a part of the scale. The Mexican burro owner is very tender of his pets, cats and domestic animals, but not of his beasts of burden; he never hesitates to get on top of a burro, no matter how heavily he is laden. The man rides the burro; his wife walks behind; and if there is anything to carry, his wife carries it. When a company of soldiers moves from one post to another, there is a company of wives following after, and the government recognizes it; because they virtually act as a commissary, and the government does not have to cook for the troops. The priests introduced the burro as an animal to relieve the overworked laboring man, or in the interests of humanity; but the porters, preceding the burro, opposed it as a labor-saving device calculated to prevent them from earning a living. The peon is opposed to improvements, machinery or anything else; and they will carry these big loads in preference to giving them to a burro, carrying, in some cases, 150 pounds 20 miles daily.

At death, Mexicans, unless very wealthy, are put in little pigeon holes formed in masonry above ground, for seven years, and the rental must be paid in advance. When the term has expired, the body will be taken out unless the rent be again paid. The body dries up in that rarefied air, and, if taken out, is set up against the side of the vault.

Guadalajara is noted for its pottery works. The market place for pottery or any other kind of work is best seen on the universal market day—Sunday. When the fashionable are at church, all the rest of the country is at market. It is a very wealthy town of some forty-seven millionaires. All business stops at midday for at least two hours; all the tramcars stop; all the building operations stop; the post office closes; you cannot get a letter. It is troublesome in most towns to get a letter. You used to have to wait until the list of all the received letters was posted on the outside of the office. In all but the city of Mexico every post office closes for two hours in the middle of the day and everything stops on account of the intensity of the heat. You will feel cold when the sun is off on account of the altitude. The difference between the sun and shade is the difference between 90° and 70°; and the difference between day time and night time is the difference between 70° and 40°.

THE CALCIUM CARBIDE INDUSTRY.

Calcium carbide and acetylene gas still continue to rival bicycles and incandescence mantles in their attractions for the genus "inventor" of this and other countries. In the first half of the present year there were no less than 117 applications for patents dealing with the apparatus for the production or utilization of calcium carbide and acetylene gas; and the total number of applications for patents in the present year will, therefore, most probably exceed that of 1896 by at least 50. These numbers must not be taken too seriously. One may very safely assume that at least 300 of the 400 and odd patents which have been granted are absolutely valueless. In Germany, where the validity of patents is settled in the Patent Office, and not in the law courts, as in our own country, a struggle is at present being carried on concerning the validity of the patent covering the production of calcium carbide in the electric furnace. This master patent was granted to Bullier, a French chemist and assistant to the noted Moissan, whose experiments upon the products of high temperature reaction in the electric furnace have become classic. Although the German carbide manufacturers are stated to have entered into treaty for the purchase of this German patent from the syndicate who hold it, the question as to validity is still unsettled.

In view of the large number of patents that exist bearing upon calcium carbide and acetylene, and of the exaggerated ideas that have been fostered concerning the future of the latter as an illuminating agent, it is not surprising that the craze for company promotion which marked the rediscovery of the compound in 1893 has continued during the present year. At least twelve new companies have been registered during the last twelve months, having as their object the production or exploitation of calcium carbide or acetylene gas. The nominal capital of these companies is over £550,000, and it would be exceedingly interesting to know what proportion of this has actually been subscribed by the general public, and also what is the amount of cash that has found its way into the pockets of patentees and company promoters connected with these twelve companies. Of this total, four are in our own country; but, so far as we know, not one of them has started to manufacture carbide.

The number of factories where carbide is at present produced is estimated at seventeen; only one of these is in this country—that owned by the Acetylene Illuminating Company and situated at Foyers, Scotland. Most of these factories are only producing carbide upon a small scale, and in several cases the manufacture is simply a secondary one, taken up temporarily because the price of carbide is still inflated, and the production offers more profit than the ordinary manufactured product of the works. When the industry has settled down on a firmer basis, these factories will, possibly, drop the manufacture. With regard to the output of carbide per electrical horse power day, and to the cost of production, some of the earlier estimates are held to have been too favorable, and it is now believed that the output will not average more than 9 pounds of carbide per electrical horse power day, and that the cost will be about £10 per ton.

Prof. Vivian Lewes has recently stated that at Foyers the average yield is 8·4 pounds per electrical horse power day from a furnace absorbing 1,000 to 1,200 amperes at 60 to 70 volts pressure. With carbide at £10 per ton, acetylene gas will cost about 18s. 8d. per 1,000 cubic feet, without any allowance for the cost of generating and purifying it, and its use as an illuminating agent will be correspondingly limited. M. Patin, of Paris, has recently applied for a patent for a process which is stated to cheapen the production of the carbide, but no details of this process have yet been published.

As regards the use of acetylene or of calcium carbide there is little progress to report. The instances in which acetylene is being regularly used as an illuminant, i. e., other than for experimental or advertising purposes, are very few. The majority of recent patents have related to generators for the production of acetylene gas from calcium carbide. The reaction between the water and the dry calcium carbide is extremely violent, and in one of the earlier forms of generator much advertised and sold, the apparatus on newly charging always produced an escape of gas into the atmosphere. This defect is said to be avoided in some of the later forms. A certain and ready detector for this defect in generators is one's nose; for acetylene rivals sulphureted hydrogen gas in the objectionable character of its odor. A recent patent proposes to avoid this difficulty by casting the carbide into sticks, and by then soaking these in naphtha or in heavy hydrocarbon oils. Acetylene has recently been experimented with as a lighting agent for trains in France and Germany; and it was stated not very long ago that the authorities in the latter country had ordered 60 tons calcium carbide for experimental purposes.

Prof. Vivian Lewes has recently discussed the application of acetylene as a ship's illuminant, and Warren has suggested the use of calcium carbide as a reducing agent in metallurgical operations. By heating together calcium carbide and metallic oxides he has obtained the metals or alloys of the metals with calcium. The present market for carbide is chiefly due to the demand for experimental or advertising purposes, and a legitimate demand for this much boomed product can hardly yet be said to exist.

With regard to the properties of gaseous and liquid acetylene, there have been a considerable number of facts published lately, and some useful information has also been given concerning the precautions which it is necessary to take in dealing with acetylene in either form. A few of the more interesting of these are given below. Acetylene does not combine with the hæmoglobin of the blood. It produces death when inhaled, simply by asphyxiation. If a vessel containing liquid acetylene be allowed to receive a blow, or to fall from a height of 6 meters to the ground, explosion with actual combustion of the acetylene will occur; if, however, the liquid acetylene be detonated by means of an incandescent platinum wire, a mere resolution of the acetylene into its elements, carbon and hydrogen, without combustion, occurs. The pressure generated in the former case is said to be equal to 5,564 atmospheres. If too little water be used in the generators when producing acetylene gas from the carbide, the heat of the reaction between the latter and the water may rise so high that an explosion will occur. The acetylene generated from commercial calcium carbide is always impure, and it should certainly be purified before use, especially if it is to be stored in a gasholder for any length of time. Phosphureted hydrogen, its most dangerous impurity, can be removed by passing the acetylene through scrubbers containing solutions of metallic salts.

Pictet recommends that the gas should be passed successively through calcium chloride solution, a lead salt solution, and sulphuric acid at —16° C., if it is to be compressed or liquefied for storage purposes. A much safer method of storing is, however, to use acetone for absorbing the gas. This chemical absorbs twenty-five times its own volume of acetylene at the normal temperature and pressure, and 300 times its own volume of the gas at a pressure of twelve atmospheres. If acetylene is to be stored in an ordinary gasholder, brine should be used in place of water for sealing the apparatus, since the gas is practically insoluble in the former. Acetylene is inferior to benzine in economy as an enricher of coal gas. The consumptions of acetylene and coal gas per candle power hour in various types of burners are as follows:

Acetylene			0·0227—0·0282 cu. ft.
Coal gas..	Non-incandescence burners.	Bat's wing...	0·406 "
		Argand......	0·353 "
		Siemens......	0·130 "
	Incandescence burner.	Auer's.......	0·095 "

These figures show how remarkably the introduction of incandescence lighting has improved the position of coal gas as an illuminant, and how difficult it will be for acetylene to displace the latter, except in those places where the price of coal gas is abnormally high. The incandescence principle has now been applied successfully to oil lamps. This fact still further handicaps the progress of acetylene as a lighting agent, since it is largely robbed of its most distinctive feature—its brilliancy—by the improvement in gas and oil illumination obtained by the application of the incandescence principle to burners and lamps. The high illuminating power of the acetylene flame is stated to be due to the exceedingly high temperature of the carbon particles; this temperature is believed to be nearly 4,000° C.—Engineering.

LAFCADIO HEARN ON JAPANESE ART.

Number fifteen of the Taiyo contains an article from the pen of Mr. Lafcadio Hearn entitled Nihon Kaiga-ron (Japanese painting), of which we give a short summary. At a meeting of the Japan Society held in London last year, Mr. Edward Strange read a paper on Japanese painting, in which he spoke in laudatory terms of the peculiarities of Japanese art. This evoked a great deal of opposition and a warm discussion ensued. Among other things, it was said that no such woman as is sketched by the Japanese artist was ever seen. The question caused so much excitement that the Japanese minister, Mr. Kalo, in order to quiet the feelings of the combatants, turned the discussion into another channel. The objections to Mr. Strange's view were evidently founded on want of initiation into the mysteries of Japanese art. This art requires special study. My own experience was that at first Japanese painting seemed anything but attractive, but after two years' study I began to see something charming in it, and from that time it grew on me until it appeared no other than marvelous. A Japanese studying western art would no doubt undergo a similar experience.

The characteristics of Japanese art which have special merit I will now endeavor to indicate: 1. The relation of individual objects to a given type, the subjection of special characteristics to an all-prevailing nature are invariably observed. By a few clever strokes of the brush an insect or a flower is made at once to declare its identity and to show its relation to the family to which it belongs. Rather than Nature herself, he prefers to embody the idea which she suggests. 2. In Japanese portrait painting, in accordance with that strong national trait which makes the suppression and concealment of emotion meritorious, there is no attempt to represent passing states of feeling. From their pictures it is difficult to decide whether a person is old or young, good or bad, much less the state of feeling of the individual represented. The high regard in which an absolutely passionless state is held may be traced to Buddhism. 3. In ordinary foreign painting great minuteness is aimed at, but the Japanese think more of general effect. Both styles have their advantages, though to carry minuteness to an extreme is considered vulgar even in the West. What are called Ukiyoye convey to my mind a most vivid impression of passing scenes, but this impression is not caused by the faithfulness of these sketches to details—by their reproduction of actually existing objects—but by a certain subtle suggestiveness which they possess. All high class art deals with the ideal rather than the real. The finest productions of Greece were founded on religious, or at any rate on transcendental, conceptions. There is a point where the art that is the result of special study and the art that comes from intuition meet, resulting in the creation of beauty of a very high

order. Both Greek and Japanese fine art alike remind us of the idea of Herbert Spencer's, that expression is form in the process of creation. 4. Greek art and Japanese art have much in common. They both aim at representing objects rather as they should be than as they are. The Greeks expressed their ideas respecting the gods and the aspirations of the human race. The Japanese represent the simple, unsophisticated happiness of beings who live in harmony with nature, but portray also the superiority of self-control and observance of the laws that govern society. Modern western art, which is occupied with present modes of life, with the greed of the money seekers, and kindred subjects, is not only far removed from the sublime idealism of the ancient Greek, but is inferior to the Japanese standard. 5. Much depends on the proclivities of the critic in all art criticism. It takes years to become accustomed to an entirely new style. I have often been amused and instructed by listening to the unvarnished opinions of Japanese children in reference to our western pictures. Appreciation of anything valuable in the world of art involves years of laborious study. This fact is constantly overlooked by persons who undertake to pronounce an opinion on oriental art.

STRAIGHTENING A CHURCH SPIRE.

A VERY skillful piece of work has just been executed by a firm of building contractors, Messrs. Hunter & Company, of Belfast, and the details of the feat performed by the firm, viz., straightening en bloc of a church spire in the County Cork, may be of interest. For some time past, says the Irish Times, it had been noticed that the spire of Trinity Church, at Newmarket, County Cork, was considerably out of plumb, and latterly was leaning over to such an extent as to threaten to topple down on the body of the sacred edifice. Such a dangerous state of affairs could not be allowed to continue, and when Colonel and Lady Mary Aldworth returned from abroad they had steps taken immediately to have the matter remedied. This was no light undertaking, as to all appearance the work necessitated the complete taking down and rebuilding of the spire of the church. A skillful architect was engaged to inspect the church tower and spire, after which a contract was entered into with the well-known firm of Hunter & Company, Belfast, to promptly execute the work. Mr. Hunter and his staff of experienced steeple-jacks attended specially from Belfast and set about the work of taking down and rebuilding the spire, but to the surprise of all, they found that the spire could not be taken down except it was done en masse, as the stones of which it is built were hermetically bound to each other with a combination of molten lead and sand which rendered it absolutely impossible to separate one stone from another, the whole spire being, as it were, one solid block. On further and closer inspection it was found that the entire building was erected in a similar manner, no other mortar or binding substance of any kind being used save the sand and molten lead—a very curious and interesting circumstance to note. The most firm and enduring (but at the same time most expensive) form of construction was, it appears, much in use in Ireland over a century ago. A huge iron shaft runs through the top portion of the spire, on which the stones were slipped like rings and irrevocably riveted with lead and sand. Under this extraordinary circumstance the idea of taking down the tower had to be abandoned, as being quite impracticable, if not utterly impossible; but the desired end has been attained in as satisfactory a manner by an ingenious and clever method adopted by the contractor and his staff. The spire has been brought back to its original true perpendicular position, and now tapers beautifully straight, standing out very handsomely, the joints being beautifully pointed with mastic cement.

HOW WORRY AFFECTS THE BRAIN.

MODERN science, says Pharmaceutical Products, has brought to light nothing more curiously interesting than the fact that worry will kill. More remarkable still, it has been able to determine, from recent discoveries, just how worry does kill. It is believed by many scientists who have followed most carefully the growth of the science of brain diseases that scores of the deaths set down to other causes are due to worry, and that alone. The theory is a simple one—so simple that any one can readily understand it. Briefly put, it amounts to this: Worry injures beyond repair certain cells of the brain; and the brain being the nutritive center of the body, the other organs become gradually injured, and when some disease of these organs, or a combination of them, arises, death finally ensues. Thus does worry kill. Insidiously, like many other diseases, it creeps upon the brain in the form of a single, constant, never lost idea; and, as the dropping of water over a period of years will wear a groove in a stone, so does worry gradually, imperceptibly, but no less surely, destroy the brain cells that lead all the rest—that are, so to speak, the commanding officers of mental power, health and motion.

Worry, to make the theory still stronger, is an irritant at certain points, which produces little harm if it comes at intervals or irregularly. Occasional worrying of the system the brain can cope with, but the iteration and reiteration of one idea of a disquieting sort the cells of the brain are not proof against. It is as if the skull were laid bare and the surface of the brain struck lightly with a hammer every few seconds, with mechanical precision, with never a sign of a let-up or the failure of a stroke. Just in this way does the annoying idea, the maddening thought that will not be done away with, strike or fall upon certain nerve cells, never ceasing, and week by week diminishing the vitality of these delicate organisms, so minute that they can only be seen under the microscope.

To Rid Caoutchouc Articles of their Disagreeable Odor.—Most caoutchouc ware has a highly unpleasant odor, which is also imparted to other goods, for which reason such articles cannot be used for many purposes. According to S. Bourne, this smell will entirely disappear, if the articles are covered on both sides with a thin layer of animal charcoal and then heated with the charcoal for 3 to 4 hours from 50° to 60° C.

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